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ABSTRACT

This curriculum guide was designed for use in secondary metal trades education in Georgia. Its purpose is to provide for development of entry level skills in metal trades in the areas of knowledge, theoretical structure, tool usage, diagnostic ability, related supportive skills, and occupational survival skills. The first section of six explains the philosophies, purposes, and goals of vocational education in Georgia. Section 2 presents employability skills related to the occupational area of metal trades, specific occupational titles, student exit points, and tasks cross referenced to the Dictionary of Occupational Titles. Section 3, the largest part of the guide, provides unit guides for each task. (For each task, a task description, student performance objective, suggested instructional activities, instructional materials, evaluation section, and suggested instruction hours are included.) Section 4 contains the curriculum structure and course outline, while student record forms and competency certificates make up section 5. The last unit contains facility guidelines, with drawings, for group instruction and individualized instruction facilities. Appendixes to the guide contain references and resources, information on teaching special needs students, and definitions of terms. (KC)

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CURRICULUM GUIDE

Georgia Department of Education

METALS CLUSTER

Developed Under Contractual Agreement with

Division of Program Development
Office of Vocational Education
Georgia Department of Education
Atlanta, Georgia 30334
Charles McDaniel, State Superintendent of Schools
1981

METALS CLUSTER

Developed By

The University of Georgia

Under the Direction of

Dr. Paul Scott

Vocational Education Materials Center

Division of Vocational Education

College of Education

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POLICIES AND PROCEDURES FOR THE CENTER

PURPOSE OF THE CENTER

The Vocational Education Materials Center functions within the division of Vocational Education, University of Georgia. This Center operates under grants from the U.S. Office of Education, and the Georgia State Department of Education with the support of the College of Education. The Center is comprehensive in its commitment and approach to the development and dissemination of materials in the broad field of Vocational Education.

The purpose of the Center is to increase the capability of Georgia's delivery system for Vocational Education. Specifically, the Center is committed to:

1. Develop materials to assist in the implementation of proposed curricula and to enhance the teaching Vocational Education.
2. Conduct and report curriculum research related to Vocational Education.
3. Provide a production and dissemination center to Vocational Education materials.
4. Provide direct experiences in curriculum development and diffusion for advanced graduate stduents.
5. Enable faculty members to participate in the development and implementation of a variety of curriculum materials.

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PURPOSE AND UTILIZATION OF THE CURRICULUM GUIDES

The purpose of this curriculum guide is to provide a suggested model for organizing vocational instructional content. In many cases, more material is available than may be needed, therefore, an instructor will need to adapt the content to meet his/her program needs.

While the guide is primarily oriented towards the classroom, whether as a primary resource or as a supplement to other teaching materials; it may also assist administrators, counselors and lay people involved in local school systems. The following outline provides an overview of the various ways these groups may utilize the curriculum guides.

a) Vocational teachers.

1. Provide a guide for organizing their program of instruction,
2. Assist in establishing program objectives,
3. Serve as a curriculum materials resource guide,
4. Improve communications with employers and advisory committees
5. Facilitate competency based instruction,
6. Facilitate either group or self-paced instruction,
7. Include content by quarter and semester,
8. Cross-reference with existing state developed instructional materials (PLACE packages and post secondary I.I.).

b) Vocational supervisors and administrators.

1. Assist in defining the scope and content of their programs,
2. Provide a means to improve curriculum management functions,
3. Serve as a guide for admissions and job placement functions,
4. Improve communications with employers and advisory committees.

c) Counseling and guidance staff.

1. Provide a data base for counseling and guidance personnel,
2. Identify student exit points (Career Options),
3. Serve as guide for admissions and job placement,

4. Correlate with new State Board of Education graduation requirements,
5. Provide specific content sequencing by quarter and semester for student scheduling,
6. Provide (a) curriculum options for the disadvantaged handicapped student, (b) curriculum modifications for SPECIAL NEEDS students, (c) typical admission requirements for regular and SPECIAL NEEDS students.

(d) Local Curriculum Coordination Committees.

1. Serve as a guide in working out articulation arrangements,
2. Improve definitions of the relationship between secondary clusters and post secondary specialized programs.

Vocational teachers, supervisors and administrators, counseling and guidance staff and local curriculum coordination committees will be primary users of this guide, however, the use of the guide is not limited to these groups, but by any and all groups directly related in designing a vocational curriculum.

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-Foreword-

It has been the privilege of the Division of Vocational Education, University of Georgia, to participate in the development of 48 curriculum guides for Georgia vocational education programs. This work was sponsored by the Division of Program Development, Office of Vocational Education, State Department of Education. The completion of these guides meets a long standing need to provide a comprehensive curriculum overview of the vocational education programs available in Georgia schools. This developmental activity involved one of the largest professional staffs ever assembled for such work. Numerous teachers, teacher educators and state staff members have either written parts of the guides or served on the field review teams. These professionals were supported by a myriad of technical people and a host of typists who literally worked from dawn to dusk to ensure that the guides were produced in a timely fashion.

Be assured that this guide is not intended to be your curriculum or the curriculum of any school. The purpose of this project staff, and I am sure of the state OVE staff, is to offer a guide with supporting resources and teaching ideas from which the vocational instructor can extract a curriculum that meets local needs. The guide, however, does simplify curriculum decisions concerning sequencing and the selection of resources and media support.

The Task Linkage Project and appropriate V'TECS catalogs were used as the beginning point for this guide and all of the others. To assure that these task listings were directly related to Georgia vocational education programs and industry, they were subjected to additional study and review by appropriate teachers.

At some point in the future, this guide will need to be revised. To ensure that such a revision truly reflects the needs of Georgia's vocational education programs, the developers need your reactions, comments and ideas. We will also be interested in how you use this guide. Let us hear from you.

Paul Scott
Curriculum Guide Projects I & II

SECTION I

PHILOSOPHY, PURPOSE & OBJECTIVES

SECTION I

Section I Content List

State Philosophy and Goals
Local Philosophy and Goals

Section I provides an overview of the philosophies, purposes and goals for vocational education in the State of Georgia. These are applied to vocational education at the secondary level, however, it is recognized that more specific philosophies, purposes and goals will be applicable depending on the character of the local program.

VOCATIONAL EDUCATION IN GEORGIA

A. PHILOSOPHY

The Georgia Board of Education perceives vocational education as a vital component in the education of the young and adult citizens of this State. Appropriate programs of vocational education and ancillary services should be made readily available to individuals in middle schools, vocational divisions of junior colleges, vocational centers, the Quick Start program and other adult programs designed to train or retrain workers for useful and satisfying employment.

Special services and assistance must be provided to those who need it in order to participate or benefit from vocational education. This includes women, minorities, the displaced homemaker and other displaced workers, those with limited English-speaking ability, the disadvantaged and the handicapped.

Since men and women spend the greater part of their lives at some form of work, the State should provide opportunities for all its citizens to develop the knowledge, skills and attitudes necessary for them to secure personally satisfying and socially useful employment.

B. PURPOSE

The purpose of vocational education shall be to improve the economic well-being of Georgia citizens by preparing individuals, through organized learning experiences, to select, obtain and advance in recognized occupations.

SECONDARY VOCATIONAL EDUCATION

A. PURPOSE

The purpose of secondary vocational education is to provide training opportunities to middle school students which are of sufficient variety and quality to enable them to make wise career choices, and at the high school level to become familiar with one or more occupations of interest and to specialize in a given occupation to the extent needed to acquire entry-level job skills and knowledge, or to enter more specialized training at the postsecondary level.

B. OBJECTIVES

1. At the middle school level, to provide exploratory PECE and Industrial Arts programs.

2. At the high school level, to provide:
   a. Exploratory and prevocational Industrial Arts programs.
   b. Prevocational programs in occupational clusters for entry into specialized programs in the 11th and 12th grades, or at the postsecondary level.
   c. Training in a single occupational skill of sufficient depth to gain entry-level employability, or the option to continue specialized training at the postsecondary level.
   d. Competency-based programs of occupational preparation which enable students advance as far as possible through a planned sequence of courses leading to an occupational objective of greatest interest to the student.
   e. Opportunities and activities for students to develop and improve affective skills needed for employment.
   f. Vocational guidance, counseling, remedial and supportive programs and services needed by students to select and complete a program of vocational education.
   g. Ancillary and supportive services necessary to ensure that all students have access to training opportunities regardless of race, sex, national origin, disadvantagement of handicap.
   h. Opportunities for students to obtain or improve Home Economics and Consumer Education skills.
   i. Vocational education programs such that 50% of those individuals who complete or leave a program of occupational preparation, and are available for employment, find employment in the field for which trained, or in a related field.

STATEMENT OF LOCAL SYSTEM PHILOSOPHY, PURPOSE AND OBJECTIVES FOR VOCATIONAL EDUCATION

(This page is intentionally left blank so that local systems may insert their copy of philosophy, purpose and goals for vocational education.)

SECTION II

PROGRAM DESCRIPTION & RELATED INFORMATION

SECTION II

Section II Content List

Employability Skills
Metals Cluster Occupational Description
Metals Cluster Program Objective
Definition of the D.O.T. Code
Description of Metals Cluster D.O.T.
Task Listing by D.O.T. Code

The major goal of vocational education in Georgia is to prepare individuals, through organized learning experiences, to select, obtain and advance in recognized occupations. Section II provides an overview of employability skills that are desirable in any occupation and relates their significance to the specific occupational area of the Metals Cluster.

The Metals Cluster Program Objective contains the specific occupational titles. These occupational titles are further explained in the description of the occupational exit points and task listing. The concentration of the program is based on these tasks.

Also included in this section are the "performance standards" that a student is expected to master before graduating from any Georgia secondary school.

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EMPLOYABILITY SKILLS

Employability skills exert a great deal of influence on a person's ability to get and keep a job. Surveys indicate that more people lose their jobs because of poor attitudes toward their job than for lack of job skills. For this reason it is important that information concerning the following employability skills be provided as an ongoing part of the program.

1. Getting a job
    a. Filling out job applications
    b. Developing a resume
    c. Preparing for a job interview

2. Keeping a job
    a. Be on time and regular in attendance
    b. Maintain a fair share of the work-load
    c. Work without supervision
    d. Meet production schedules
    e. Properly care for and use equipment
    f. Dress appropriately for the job
    g. Maintain good personal hygiene
    h. Develop and maintain good communication with supervisors and co-workers

A recent study sponsored by the Illinois Department of Adult, Vocational and Technical Education and conducted by the University of Illinois, "Survival Skills: Mastering the Human Aspects of Work", has identified twelve topics that might be developed into instructional modules for teaching occupational survival skills. The author, Robert E. Nelson, outlines these topics listed below and on the next page, each followed by a general objective which indicates the relationship between the topic and the survival skills required to maintain a job.

*"1. Working in an Organization: To familiarize students with the reasons for the formation of organizations and the common characteristics of organizations.

2. Understanding Self and Others: To have students develop insights into causes of human behavior and learn to interpret their own behavior and the behavior of other.

3. Motivation for Work: To have students develop and understanding of motivations into the work they perform.
4. Interpersonal Relations: To have students develop concepts and skills in interpersonal relations and apply them to work situations.
5. On-the-Job Communication: To have students understand the importance of effective communication and learn ways of communicating effectively on the job.
6. Using Creativity on the Job: To make students aware of their creative potential and to practice using their creative ability in hypothetical on-the-job situations.
7. Authority and Responsibility: To have students develop an understanding of the concepts of authority, power, influence, and responsibility as they apply to work situations.
8. Problem Solving: To have students develop skill in applying problem solving to their work.
9. Coping with Organizational Change: To make students aware of the process of organizational change and the techniques for coping with organizational change.
10. Coping with Organizational Conflict: To make students aware of the sources and types of conflicts encountered on the job and recognize ways of coping with conflicts in an organization.
11. Leadership: To have students recognize the need for leadership in work groups and increase their understanding of the leadership role in work situations.
12. Adapting and Planning for the Future: To have students develop perspectives of work in the future and the ability to plan for anticipated changes in their work roles."

*Abstracted from the article, "Survival Skills: Mastering the Human Aspects of Work," by Robert E. Nelson, American Vocational Journal, November 1977.

DESCRIPTION OF OCCUPATION

METALS OCCUPATIONS*

Nature of the Work

Machine tool operators use machine tools such as lathes, drill presses, milling machines, grinding machines, and punch presses to shape metal to precise dimensions. Although some operators can work with a wide variety of machine tools, most specialize in one or two types.

Operators fall into two broad skill categories-semiskilled and skilled. Semiskilled operators are essentially machine tenders who perform simple, repetitive operations that can be learned relatively quickly. Skilled operators can perform varied and complex machining operations. Both skilled and semiskilled operators have job titles related to the kind of machine they operate, such as milling machine operator and drill press operator.

Most machine tool operators fall into the semiskilled category. Their jobs vary according to the type of machine they work with; however, there are many tasks common to most machine tools. Typically, semiskilled operators place rough metal stock in a machine tool on which the speeds and operation sequence already have been set by skilled workers. By using special, easy-to-use gages they watch the machine and make minor adjustments. However, they depend on skilled machining workers for major adjustments when their machine is not working properly.

The work of skilled machine tool operators is similar to that of all-round machinists, except that it usually is limited to only one type of machine and involves little or no hand fitting or assembly work. Skilled machine tool operators plan and set up the correct sequence of machining operations according to blueprints, layouts, or other instructions. They adjust speed, feed, and other controls, and select the proper cutting instruments or tools for each operation. Using micrometers, gages and other precision measuring instruments, they compare the completed work with the tolerance limits given in the specifications. They also may select cutting oils to keep the metal work piece from getting too hot and lubricating oils to keep the machine tools running smoothly.

Working Conditions

Most machine shops are clean, well lighted, and well ventilated. Noise levels have been reduced with the introduction of better designed machine tools. However, some machine tools, such as screw machines, are still very noisy. To combat this noise, operators often wear earmuffs or earplugs. Coolants (the liquids used to reduce friction) are well contained on modern machine tools, but operators of older machine tools sometimes have to stand on slippery floors caused by spilled coolants. Good shop practices and attention to cleanliness, however, can significantly reduce this danger.

Powerful, high-speed machine tools can still be dangerous, though, if strict safety rules are not observed. Machine tool operators must wear safety glasses and other protective devices to protect themselves from flying metal particles. They cannot wear loose-fitting clothes or jewelry as these might get caught in the machine, injurying the operator or damaging the machine.

Places of Employment

More than 500,000 machine tool operators were employed in 1978. Most worked in factories that produce fabricated metal products, transportation equipment, and machinery in large quantities. Skilled machine tool operators also worked in production departments, maintenance departments, and toolrooms.

Machine tool operators work in every State and in almost every city in the United States.

Training, Other Qualifications, and Advancement

Most machine tool operators learn their skills on the job. Beginners usually start by observing experienced operators at work. Later they learn to use measuring instruments and to make elementary computations needed in shopwork. When trainees first operate a machine, they are supervised closely by more experienced workers. After gaining some experience themselves, beginners often take over more of the duties associated with the tools they operate. For example, they may learn to adjust feed speeds and cutting edges, instead of calling upon other workers to perform these tasks. Some also may learn to read blueprints and plan the sequence of machining work.

Individual ability and effort largely determine the time required to become a machine tool operator. Most semiskilled operators learn their jobs in a few months, but becoming a skilled operator often requires 1 to 2 years. Some companies have formal training programs for new employees.

Although no special education is required for semiskilled jobs, a person seeking such work can improve their opportunities by completing courses in mathematics and blueprint reading. In hiring beginners, employers often look for persons with mechanical aptitude and some experience working with machinery. Physical stamina is important since much time is spent standing. Applicants should be able to work independently. They also should not mind working in a relatively small workspace. Although much of the work is tedious, many machine tool operators derive satisfaction from seeing the results of their work.

Skilled machine tool operators may become all-round machinists, tool-and-die makers, or advance to jobs in machine programming and maintenance.

Employment Outlook

Job opportunities for machine tool operators should be fairly plentiful in the years ahead. Employment in the occupation is expected to increase about as fast as the average for all occupations through the 1980's. In addition to openings arising from growth, many thousands of openings are expected to occur each year in this large occupation as operators retire, die or transfer to other fields of work.

More machine tool operators will be needed as metalworking industries expand their output. However, the use of faster and more versatile automatic machine tools and numerically controlled machine tools will result in greater output perworker and tend to limit employment growth. Other factors that may slow growth in this occupation are the increasingly important new processes in metalworking, such as electrical discharge and ultrasonic machining, and the use of powered metals that reduce the machining necessary for a final product.

Workers with thorough backgrounds in machining operations, mathematics, blueprint reading, and a good working knowledge of the properties of metals will be better able to adjust to the changing job requirements that will result from technological advances.

Trade Unions

Most machine tool operators belong to unions, including the International Association of Machinists and Aerospace Workers; the International Union, United Automobile, Aerospace and Agricultural Implement Workers of America ; the International Union of Electrical, Radio and Machine Workers; the International Brotherhood of Electrical Workers; and the United Steelworkers of America.

Related Occupations

The occupations most closely related to machine tool operators are, of course, the other machining occupations. These include all-round machinists, setup workers (machine tool), tool-and-die makers, and instrument makers.

Other occupations that require precision and skill in working with metal include arc cutters, blacksmiths, gunsmiths, locksmiths, patternmakers (metal), and welders.

SHEET METAL WORKERS*

Nature of the Work

Sheet-metal workers fabricate and install sheet-metal ducts for air-conditioning, heating, and ventilating systems; flat metal for kitchen walls and counters; and stamped metal for roofing and siding. They also install roof gutters and downspouts for rainwater drainage and make skylights and vents for industrial buildings. Some workers specialize in either shopwork or onsite installation; others do both.

Sheet-metal workers fabricate much of the metal at the shop. Working from blueprint specifications, they measure, cut, bend, shape, and fasten most of the pieces that will be used on the job. Tapes and steel rulers are used for measuring; hand shears, hacksaws, and power saws for cutting; and specially designed, heavy is measured and cut, workers then bolt, cement, rivet, solder or weld the seams and joints together to form ducts, pipes, tubes, and other items.

At the construction site, sheet-metal workers usually just assemble and install pieces fabricated at the shop. Sometimes, however, workers use hammers, shears, and drills to make parts by hand at the worksite.

Workers install ducts, pipes, and tubes by joining them end to end and hanging them with metal hangers secured to a ceiling or a wall. To hold the pieces together, workers may bolt, weld, glue or solder or use specially formed sheet-metal for connections.

Molded and pressed sheet-metals, such as roofing and siding, usually are measured and cut on the job. After securing the first panel in place, workers interlock and fasten the grooved edge of the next panel into the grooved edge of the first. They nail the free edge of the panel to the structure. This two-step process is repeated for each additional panel. Finally, at joints, along corners, and around windows and doors, workers fasten machine-made molding for a neat, finished effect.

Some sheet-metal workers specialize in testing, balancing, and adjusting existing air conditioning and ventilation systems to make sure they are properly functioning.

Working Conditions

Many sheet-metal workers do fabricating and layout work primarily in shops. Others work either indoors or outdoors at the construction site. Sheet-metal workers generally work more regularly than most construction trades because most work is done indoors.

When installing gutters and skylights, they work high above ground. When installing ventilation and air-conditioning systems, they are required to do a considerable amount of bending, lifting, standing, and squatting in close quarters or in awkward positions. Sheet-metal workers risk cuts and burns from materials and tools. The injury rate for workers in this trade is higher than the average for all construction workers.

Places of Employment

Sheet-metal workers in the construction industry-who numbered about 60,000 in 1978-are employed mainly by contractors who specialize in heating, refrigeration, air-conditioning and air pollution equipment, and by general contractors engaged in residential, industrial and commercial building. Additional sheet-metal workers are employed by government agencies or businesses that do their own construction and alteration work. Very few are self-employed.

Sheet-metal workers are employed throughout the country, but jobs are concentrated in metropolitan areas.

Training, Other Qualifications, and Advancement

Unlike many other construction trades, the vast majority of sheet-metal workers learn their trade through apprenticeship programs. Some acquire their skills by working as helpers, observing and being taught by experienced workers.

The apprenticeship program usually consists of 4 years of on-the-job training, in addition to related classroom instruction. On the job, apprentices learn to use the tools, machines, equipment, and materials of the trade. In the first 2 years, they learn to measure, cut, bend, fabricate, and install sheet-metal. They begin with duct work and gradually advance to fabricating decorative pieces. Toward the end of their training, they learn to use materials such as plastics and acoustical tile, which may be substituted for metal on some jobs. Trainees spend considerable time in the classroom learning drafting, blueprint reading, applied mathematics, welding, and the principles of heating, air-conditioning, and ventilating systems. Safety is stressed throughout the program. In addition, apprentices learn the relationship between sheet-metal work and other construction work.

Workers who pick up the trade informally usually begin by carrying metal and cleaning up debris in a metal shop. While there they can learn about materials and their costs as well as tools and their uses. Then, as employers permit, helpers learn to set switches and operate levers on machines that bend or cut metal. In time, helpers leave the shop and go out on the job to learn installation.

Applicants for jobs as apprentices or helpers should be in good physical condition and have mechanical aptitude. Apprentices should have a high school or vocational school education or equivalent education. Courses in mathematics, mechanical drawing, and shop provide a helpful background for learning the trade.

Sheet metal workers in construction may advance to supervisory jobs or may go into the contracting business.

Employment Outlook

Employment of sheet-metal workers in construction is expected to increase faster than the average for all occupations through the 1980's. In addition to jobs from employment growth, many openings will arise as experienced workers retire, die, or leave work for other reasons.

As population and business grow, more sheet-metal workers will be needed to install air-conditioning and heating duct work and other sheet-metal products in new houses, stores, offices, and other buildings. The demand for air conditioning systems in older buildings as well as the need to make existing systems more energy efficient also will boost employment growth. Prefabrication is not likely to have much of an effect on this occupation because most sheet-metal work has to be custom-made according to the needs of a particular job.

Although employment is expected to increase over the long run, job openings may fluctuate from year to year due to ups and downs in construction activity. When construction activity is depressed, jobs for sheet-metal workers may be available in other industries.

Trade Union

A large portion of sheet-metal workers are members of the Sheet-Metal Workers' International Association.

Related Occupations

Other occupations in which workers lay out and fabricate metal products include fabricator-assemblers of metal products; all-round machinists; metal patternmakers; and ornamental ironworkers.

Sources of Additional Information

For more information about apprenticeships or other work opportunities, contact local sheet-metal contractors or heating, refrigeration, or air-conditioning contractors; a local of the union mentioned above; a local joint union-management apprenticeship committee; or the nearest office of the State employment service or apprenticeship agency.

For general information about sheet-metal workers, contact: Sheet Metal and Air-Conditioning Contractors' National Association, Inc., 8224 Old Courthouse Rd., Tyson's Corner, Vienna, VA 22180.

WELDERS*

Nature of Work

Welding is the most common way of permanently joining metal parts. Typically heat is applied to the metal pieces to be joined, the parts melt, fuse, and then form a permanent bond. Because of its strength, welding is used to construct and repair parts of ships, automobiles, spacecraft, and thousands of other products. It also joins beams and steel reinforcing rods in buildings, bridges, and highways.

There are three common ways to create the heat that is applied to the parts being joined. In electric arc welding, the most frequently used process, heat is created in the arc as electric current flows through the arc between the tip of the welding electrode and the metal. In resistance welding, heat is created in the weld metal by resistance to the flow of current through the metal. In gas welding, the flame from the combustion of burning gases melts the metal. In arc and gas welding, filler materials, called welding electrodes or welding rods, are melted and added to the weld puddle to give the joint greater strength. It is the welder's job to control the amount of heat and the size of the melted area and to add the proper amount of filler material so that they form a strong joint.

Since welding processes differ and are used for many purposes. the equipment and skill levels of welders vary. Some jobs require highly skilled manual welders who know how to safely use gas and electric arc welding equipment in all positions and are able to plan their work from drawings or specifications. Other jobs can be handled by unskilled welding machine operators who simply press a button to start the welding machine. Skilled welders know the characteristics and properties, such as melting points of steel, aluminum, and other commonly used metals. Examples of skilled welders are maintenance welders, pipe welders, and welders who construct ships and bridges.

In ship construction, welders join the steel plates, beams, and pipes. Some joints to be welded are on the floor, some are welded to insure that the ship will not break apart in rough seas.

Ship welders generally use manual arc welding equipment, although semiautomatic equipment is used in some places. After welders read instructions to learn which materials and welding method to use, they obtain supplies from the storage area. To form a joint by arc welding, they use an electrode in a holder attached to an electrical cable coming from a welding power supply. Another such cable is attached to the metal being welded. Thus, electricity will flow through the welding electrode, through the arc to the metal being welded, and back to the power supply. The power supply can be adjusted to provide the correct amount of current. When the power is turned on, welders "strike an arc" by briefly torching the electrode to the metal to start the electricity flowing and then pulling the rod back to form a small arc gap over which the current must flow. If the distance between the electrode and the metal is correct, a stable electric arc will bridge the space; the heat from the arc melts the electrode and the metal. Welders move the arc along the length of the joint. As the electrode melts and becomes shorter, they move the holder closer to the metal to keep the right distance from the arc. They replace very short electrodes.

Maintenance welders repair tools, machines, and equipment. Often they bring portable gas torches, hoses, and tanks to the job because electricity may not be available.

When working on a broken pipe, for example, they examine the pipe and prepare the break for repair. Maintenance welders then select a welding filler rod appropriate for the job. Next, they light the torch and adjust regulators on the cylinders of fuel gas, such as acetylene, and oxygen to obtain the right gas mixtures and flame. Then they heat the edges of the break with the torch. As the metal begins to soften, welders melt the end of the filler rod in the hot liquid metal as they carefully move the torch and rod along the break. Welders must keep the torch the correct distance from the metal, apply heat correctly, and repair the break with filler material.

Not all welders have the skills required of shipbuilding or maintenance welders. For example, less skilled workers use semiautomatic arc weld equipment to weld automobile frames. Semiautomatic equipment automatically supplies the proper amount of arc heat and filler material to the joint. For example, assembly lines bring car frames to welders who then position their welding guns near the parts to be welded and operate a switch on the handle which automatically starts the arc. They guide the arc to complete the required joints before the assembly line takes the frame to another worker. Like other welders, they are responsible for the quality of the joint. However, the job usually requires less manipulative skill because all parts are identical and each is welded in the same position.

Large factories, having many identical parts to be welded may reduce production costs by using automatic arc, electron beam, or resistance welding machines. Workers who operate such machines to weld automobile mufflers and washing machines, for example, need little knowledge of welding. These workers, frequently called welding machine operators to distinguish them from more skilled, manual welders, place the parts to be joined in fixtures on the machine and push a button. The machine then clamps the part in place and positions it, as necessary, to complete the welding cycle. After the cycle is finished, operators remove the welded parts and load the machine again.

The work of arc and flame cutters is closely related to that of welders. Using heat from burning gases or an electric arc, cutters cut and trim rather than join metal. Some electrically and mechanically operated machines follow guidelines automatically.

Working Conditions

Welders are exposed to more potential hazards than most other workers. They use protective clothing, safety shoes, goggles, helmet with protective lenses, and other devices to prevent burns and eye injuries. Although lighting and ventilation usually are adequate, some metals give off toxic gases and fumes as they melt. Workers often are in contact with rust, grease, and dirt on metal surfaces. Machine operators, however, are largely free from hazards associated with manual welding. A face shield or goggles generally are adequate protection. Skilled workers, working in welding booths, often have long periods of isolation from other workers.

Places of Employment

In 1978, about 679,000 welders and flame cutters were employed, including a relatively small number of cutters who used both flame and arc-cutting equipment. Almost two-thirds of all welders help manufacture durable goods; for example, boilers, bulldozers, trucks, ships, and heavy machinery. Most of the rest repair metal products or help construct bridges, large buildings, and pipelines.

Training, Other Qualifications, and Advancement

Though several years of on-the-job training are required to become a skilled welder, less skilled work can be learned on the job in a few months. Some welding operators, for example, can operate a machine in a few hours and handle all parts of their job in a week.

Beginners often start in simple production jobs where the type and thickness of the metal and the position of the welding operation rarely change. As the need arises, supervisors or experienced workers teach new employees how to weld vertical and overhead joints and different metals. Many large companies train their own welders. A few companies have apprenticeship programs including classroom and on-the-job training that last several years.

Persons planning careers as welders or cutters need manual dexterity, good eyesight and good eye-hand coordination. They should have the ability to concentrate on detailed work for long periods, and be physically able to bend, stoop, and work in awkward positions. Most employers prefer applicants who have high school or vocational school training in welding. Courses in ship mathematics, mechanical drawing, blueprint reading, and chemistry also are helpful.

New technological developments, especially in the nuclear energy and aerospace, require new skills. Because of the hazards of nuclear power plant operation or high-speed air and space travel, both industries demand high standards of reliability for welds. Before being assigned to work on buildings, bridges, pipelines, or other jobs where the strength of the weld is highly critical, welders may be required to pass an examination of their welding skills given by an employer or government agency. Welders who pass such examinations generally are referred to as "certified welders."

Promotion opportunities for welders are good. Some welding machine operators learn skilled welding jobs; skilled welders may be promoted to welding inspectors, technicians, or supervisors. Experienced workers who have obtained college training are in great demand as welding engineers to develop new applications for welding. A small number of experienced welders open their own repair shops.

Employment Outlook

Employment for welders is expected to increase faster than the average for all occupations through the 1980's because of the greater use of welding. In addition, many jobs should arise each year as welders retire, die, or transfer to other occupations. Job opportunities may vary as the economy fluctuates.

Increases in population and income are expected to stimulate demand for cars, buildings, heavy machinery, appliances, and thousands of other products that welders help make. Employment of welders also is expected to increase as welding replaces other methods of joining metals. Welding generally is cheaper than other methods of joining metal parts, and it is being used more frequently in the manufacturing and construction industries.

Trade Unions

Welders belong to many different unions. Among these are the International Association of Machinists and Aerospace Workers; the International Brotherhood of Boilermakers, Iron Shipbuilders, Blacksmiths, Forgers and Helpers; the International Union, United Automobile, Aerospace and Agricultural Implement Workers of America; the United Association of Journeymen and Apprentices of the Plumbing and Pipe Fitting Industry of the United States and Canada; and the United Electrical, Radio and Machine Workers of America.

Related Occupations

Welders are highly skilled workers who must be very familiar with the properties of metal and use hand-held equipment or machine to factory or construction work. Other people with similar duties are blacksmiths, forge ship workers, all-round machinists, instrument makers (mechanical), machine tool operators, and tool-and-die makers.

Sources of Additional Information

For further information on training and work opportunities for welders, contact local employers or the local office of the State employment service. For general information about welders, write to: The American Welding Society, 2501 NW 7th Street, Miami, Florida 33125; International Union, United Automobile, Aerospace and Agricultural Implement Workers of America, 8000 East Jefferson Avenue, Detroit, Michigan 48214.

OCCUPATIONS IN AIRCRAFT, MISSILE, AND SPACECRAFT MANUFACTURING*

Nature and Location of the Industry

Major aircraft, missile, and spacecraft firms contract with government or private business to produce an aerospace vehicle. As a contractor, the firm is responsible for managing and coordinating the entire project. This involves design, production, assembly, and inspection of the vehicle.

Although aircraft, missile, and spacecraft manufacturers generally make many components of a craft and do final assembly work themselves, thousands of subcontractors are involved in the production of parts or supplies the original firm cannot or does not want to produce, such as bearings, specialized metal parts, or even entire sections of an aircraft. Other subcontractors produce subassemblies such as communication or guidance equipment of jet engines. Some firms depend on still other subcontractors to supply parts for subassemblies.

In producing an aerospace vehicle, the engineering department first prepares design drawings and specifications, usually after much consideration of the purchaser's needs. Then the production department works on details for machines, materials, and operations needed to manufacture the vehicle. Often, special tools and machines must be designed and produced to make parts or to assemble the aerospace vehicle, especially when a firm is developing an experimental or ultrasophisticated vehicle requiring specially designed parts or assemblies.

After parts and components are developed, they are tested and inspected many times before being assembled. Once the tests prove satisfactory, assembly of the entire craft may begin. Finally, the finished vehicle is checked out by a team of mechanics and flight-tested, if it is an aircraft, before it is delivered.

Metals Occupations in the Industry

Sheet-Metal Occupations. Following blueprints and other engineering information, sheet-metal workers (D.O.T. 804.281-010) shape complicated parts from sheets of thin metal by hand or machine. When shaping parts by hand, these workers either pound them with mallets or bend, cut, or punch them with handtools. Machine methods use power hammers and presses, saws, tube benders, and drill presses. This work requires much precision since parts must fit perfectly.

Less skilled workers operate machines to fabricate parts required in large numbers. Some of these workers are punch press operators (D.O.T. 615.482-022, .682-014., .685-030, and 617.685-026), power hammer operators (D.O.T. 617.682-014) and power shear operators (D.O.T. 615.482-034 and .685-034).

Machining and Tool Fabrication Occupations. Machining and tool fabrication workers use a wide variety of machines and handtools to make metal parts of machines or other products. Many of these workers are in engine and propeller plants, which are basically metalworking establishments; fewer are required in plants that assemble complete aerospace vehicles.

The most skilled machinists are the all-round machinists (D.O.T. 600.280-022) who plan the work and set up and operate several types of machine tools. They perform highly varied, non-repetitive machining operations, frequently producing parts for experimental and prototype vehicles.

Machine tool operators (D.O.T. 601.280-054), who produce metal parts in large volume, use machine tools such as lathes, drill presses, or milling machines. Skilled operators set up work on a machine and handle more difficult and varied jobs. Less skilled operators do more repetitive work.

Other machining and tool fabrication workers produce parts needed for the manufacture of aerospace vehicles. On the basis of information received from an engineering department, jig and fixture builders (D.O.T. 693.280-046) build jigs-metal devices used as guides for tools. Tool-and-die makers (D.O.T. 601.280-046) make the cutting tools and fixtures used in machine tool operations, and the dies used in forging and punch press work.

Other Metal Processing Occupations. Some of the many other metalworking occupations are tube benders (D.O.T. 709.684-090 and .687-050), who form tubing used for oil, fuel, hydraulic, and electrical conduit lines and riveters (D.O.T. 800.684-010) and welders (D.O.T. 810.384-014; 811.684-014; and 819.281-022, .361-010, .381-010, .384-010 and .684-010), who use mechanical and electrical devices to join fabricated parts.

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*Occupational Outlook Handbook, 1980 edition.

METALS CLUSTER PROGRAM OBJECTIVE

Given appropriate instruction, as suggested by this guide, a student completing the program should demonstrate entry level skills in Metals Cluster occupations in the areas of knowledge, theoretical structure, tool usage, diagnostic ability, related supportive skills and occupational survival skills.

As the student progresses through the program, sufficient competencies will be acquired to enable the student to enter the occupational field at the following D.O.T. Codes.*

Lathe Operator	(D.O.T. Code 604.685-026)
Sheet Metal Helper	(D.O.T. Code 619.686-022)
Milling Machine Operator	(D.O.T. Code 605.685-030)
Drill Press Operator	(D.O.T. Code 606.682-014)
Sheet Metal Worker	(D.O.T. Code 804.281-010)
Shielded-Metal Arc Welder	(D.O.T. Code 810.384-014)
Oxyacetylene Welder	(D.O.T. Code 811.684-014)
Brazer Assembler	(D.O.T. Code 813.684-010)
Welder Helper	(D.O.T. Code 819.687-014)

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*Dictionary of Occupational Titles, 1977 ed.

DEFINITION OF D.O.T. CODE*

As a result of technological, economic and sociological influences, nearly every job in the economy is performed slightly differently from any other job. Every job is also similar to a number of other jobs. In order to look at the millions of jobs in an organized way, job titles are designated a 9-digit occupational code. Each set of three digits in the D.O.T. Code has a specific purpose or meaning that differentiates it from all other codes.

The first three digits of the D.O.T. Code identify a particular occupational group. In the code 652.382-010, the first digit indicates an occupational category. The second digit refers to a division within the occupational category. The third digit defines a specific occupational group within a division.

The middle three digits of the D.O.T. Code 652.382-010 are the worker function rating of the tasks performed in the occupation. Every job requires a worker to function, to some degree, in relation to data, people and things. A separate digit expresses the worker's relationship to each of these three groups. Worker functions involving more complex responsibility and judgment are assigned lower numbers while functions which are less complicated have high numbers.

The last three digits of the D.O.T. Code 652.382-010 indicate the alphabetical order of titles within 6-digit code groups. They serve to differentiate a particular occupation from all others. A number of occupations may have the same first six digits, but no two D.O.T. Code can have the same nine digits.

*Dictionary of Occupational Titles, 1977 ed.

DESCRIPTION OF OCCUPATIONAL EXIT POINTS*

604.685-026 LATHE OPERATOR

Tends one or more previously setup lathes, such as turret lathes, engine lathes, and chucking machines, to perform one or series of repetitive operations, such as turning, boring, threading, or facing, of metal workpieces according to specifications on production basis. Lifts workpiece manually or with hoist, and positions and secures it between lathe centers, in chuck or in holding fixture, using wrench, or places it with automatic loading mechanism. Starts machine and turns handwheels to feed tools to workpiece, or engages automatic feed. Observes machining operation to detect malfunction or excessive tool wear. Verifies conformance of machined work to specifications, using fixed gauges, calipers, and micrometers. Changes worn tools, using wrenches. May machine plastics or other non-metallic materials.

619.686-022 SHEET-METAL HELPER

Assists workers engaged in fabrication of structural or sheet metal products, performing any combination of the following tasks: Lifts, positions, and removes workpieces from machines to assist in fitting and welding. Holds tape and rods and marks reference points to assist in layout. Loads, stacks, and transports stock, tools, dies, and work in process by hand or truck. Attaches rope or grappling equipment to workpieces to prepare workpiece for moving by crane or jig. Cleans and scrapes metal preparatory to fabricating, welding, painting, or shipping, using scraping tool, abrasive, or placing in solvent bath. Paints metal stocks, using paintbrush. Picks up and trucks scrap from work areas. May be designated by trade as IRONWORKER HELPER, SHOP or SHEET-METAL-HELPER.

605.685-030 MILLING MACHINE OPERATOR

Tends one or more previously setup milling machines to mill surfaces of metal workpieces to specifications on production basis. Positions and secures workpiece in fixture or feeding device. Starts machine, and turns handwheel to feed workpiece to cutter or vice versa, or engages feeding mechanism. Changes work cutters, using wrenches. Verifies conformance of work to specifications, using instruments, such as fixed gauges, according to programmed cycle. May turn controls to adjust feed rate or workpiece or speed of cutting tool. May turn valve handle and direct flow of coolant against cutter and workpiece. May mill non-metallic materials.

606.682-014 DRILL PRESS OPERATOR

Sets up and operates single-spindle drill press to perform such machining operations as drilling, countersinking, spotfacing, and tapping holes in metal workpieces, according to specifications, tooling instruments, standard charts, and knowledge of machining procedures. Reads blueprint, or job order and tools to be used. Secures specified tool in spindle. Lifts workpiece manually or with hoist, places it in fixture or jig or on machine table, and secures it with clamps or holds it in position under spindle. Moves controls to set cutting speed, feed rate, and depth of cut. Engages power or automatic feed or manually operates feed lever to feed tool to specified depth in workpiece. Turns valve handle to start flow of coolant against tool and workpiece or dips tool in cutting oil prior to mounting. Verifies conformance of machined workpieces to specifications, using such measuring instruments as calipers, micrometers, and fixed gauges. May position and secure drilling jig to guide cutting tool. May tilt table or spindle to machine holes at specified angles. May work on non-metallic materials. May measure, mark, scribe, and center punch workpieces to mark hole locations.

804.281-010 SHEET-METAL WORKER

Fabricates, assembles, installs, and repairs sheet metal products and equipment, such as control boxes, drainpipes, ventilators, and furnace casings, according to job order to blueprints. Selects gauge and type of sheet metal according to product being fabricated and knowledge of metal. Locates and marks dimension and reference lines on metal sheet (SHEET-METAL LAY-OUT WORKER). Sets up and operates fabricating machines, such as shears, brakes, bending rolls, punch and drill presses to cut, bend, and straighten sheet metal. Shapes metal over anvils, blocks, or forms, using hammer. Sets up and operates soldering and welding equipment to join together sheet metal parts. Smooths seams, joints, or burred surfaces, using files and portable grinder or buffer. Installs assemblies in plant or worksite according to blueprint specifications, using handtools and portable power tools. Inspects assemblies and installation for conformance with specifications, using measuring instruments, such as calipers, scales, and micrometers. May be designated according to type of metal used as COPPERSMITH; PRODUCT-DEVELOPMENT WORKER; ROOFER, METAL; SHEET-METAL INSTALLER; SHEET-METAL WORKER, MAINTENANCE; SHOP MECHANIC.

810.384-014 SHIELDED METAL ARC WELDER

Welds together metal components of such products as pipelines, automobiles, boilers, ships, aircrafts, and mobile homes, as specified by layout, blueprints, diagram, work order, welding procedures, or oral instructions, using electric arc-welding equipment. Obtains specified electrode and inserts into portable holder or threads consumable electrode wire through portable welding gun. Connects cables from welding unit to obtain amperage, voltage, slope, and pulse, as specified by WELDING ENGINEER or WELDING TECHNICIAN. Starts power supply to produce electric current. Strikes (forms) arc which generates heat to melt and deposit metal from electrode to workpiece and join edges of workpiece. Manually guides electrode or gun along weld line, maintaining length of arc and speed of movement to form specified depth of fusion and bead, as judged from color of metal, sound of weld, and size of molten puddle. Welds in flat, horizontal, vertical, or overhead positions. May manually apply filler rod to supply weld metal. May clean or degrease weld joint or workpiece, using wire brush, portable grinder, or chemical bath. May repair broken or cracked parts and fill holes. May prepare broken parts for welding by grooving or scarfing surfaces. May chip off excess weld, slag, spatter, using hand scraper or power chipper. May preheat workpiece, using hand torch or heating furnace. May position and clamp workpieces together or assemble them in jig or fixture. May tack assemblies together. May cut metal plates or structural shapes (ARC CUTTER WELDING). May be designated according to type of equipment used as WELDER, CARBON ARC WELDING; WELDER, FLUX-CORED ARC WELDING; WELDER, GAS-METAL ARC WELDING; WELDER, GAS-TUNGSTEN ARC WELDING; WELDER, HAND, SUBMERGED ARC WELDING; WELDER, PLASMA ARC WELDING; WELDER, SHIELDED-METAL ARC WELDING, BOILER-MAKER boilermaking. Important variations include types of metals welded, subprocesses used, trade name of equipment used, worksite (inplant, job shop, construction site, shipyard), method of application (manual, semiautomatic), high-production or custom, level of ambidexterity required, type of joints welded (seam, spot, butt). May be required to pass employer performance tests or standard tests to meet certification standards of governmental agencies or professional and technical associations.

811.684-014 OXYACETYLENE WELDER

Welds metal parts, using gas welding equipment as specified by layout, welding diagram, or work order. Positions parts in jigs or fixtures on bench or floor, or clamps parts together along layout marks. Selects torch, torch tip, filler rod and flux, according to welding chart specifications or type and thickness of metal. Connects regulator valves and hoses to oxygen and fuel gas cylinders, and welding torch. Turns regulator valves to activate flow of gases, lights torch and adjusts gas mixture and pressure to obtain desired flame, based on knowledge of gas-welding techniques. Holds torch at proper angle to metal and guides along weld joint, applying filler rod to molten area to form weld. Examines weld for bead size and other specifications. Repairs broken or cracked metal objects, fills holes, and builds up metal parts. May apply flux to workpiece instead of filler rod. May preheat workpiece in furnace or with torch. May layout, position and tack weld workpieces. May weld along vertical or overhead weld lines. May scarf or groove weld prior to applying filler metal, using gas welding equipment. May chip or grind off excess weld, slag, or spatter. May clean or degrease parts, using wire brush, portable grinder, or chemical bath. May cut metal plates or structural shapes using gas torch. May be designated according to type of gases used such as WELDER, ACETYLENE (welding); WELDER, OXYACETYLENE (welding); WELDER, OXY-HYDROGEN (welding). Important variations include type of metals welded, products, subprocesses, trade name of equipment, worksite (inplant, job shop, construction site, shipyard), high production or custom, level of ambidexterity required or type of joints welded (seam, spot, butt). May be required to pass employer performance tests or standard tests to meet certification standards of governmental agencies or professional and technical associations.

813.684-010 BRAZER ASSEMBLER

Brazes (bonds) together components to assemble metal parts as specified by layout, work order, or blueprints, using hand torch. Aligns and clamps workpieces together, using rule, square, or template or sets up and places them in fixtures, jigs, or vise. Cleans joints of workpieces using wire brush or by dipping them into cleaning solution. Selects torch tip, flux, and brazing alloy from data charts or work order. Connects hoses from torch to regulator valves and cylinders of oxygen and specified fuel gas, acetylene or natural. Turns valves to start flow of gases, lights flame, and adjusts pressure and mixture of gases to obtain desired color and size of flame. Brushes flux onto joint of workpiece or dips braze rod into flux to prevent oxidation of metal. Guides torch and rod along joint or seam of workpeice to heat to brazing temperature and melt braze alloy to bond workpieces together. Examines seam and rebrazes defective joints. May braze together broken parts and cover holes to repair leaks. May specialize in bonding parts with soft solder and be designated SOLDERER, TORCH (welding) II. May melt and separate brazed joints, using hand torch or furnace, remove and straighten components, and rebraze joints to repair misaligned or damaged assemblies and be designated BRAZER, REPAIR AND SALVAGE (welding). May braze together seams of metal sheets, strips, screening, or wire cloth, using torch mounted on manually guided crawler, and be designated BRAZER, CRAWLER TORCH (welding).

819.687-014 WELDER HELPER

Performs any combination of following duties to assist workers in welding, brazing, and thermal and arc cutting activities: Moves workpieces, tools, and supplies, manually or by handtruck. Lifts, moves and holds, or clamps workpieces to table, into jigs, or into position as directed, manually or by using hoist, pry bars, wrenches, hammer and wedges. Cleans workpieces to remove impurities, such as slag, rust and grease, using wire brush, portable grinder, hand scraper, or chemical solutions. Connects hoses from hand torch to oxygen and fuel gas cylinders or connects cables from power source to electrode holder and workpiece or fixture. Starts gasoline engine to activate electric generators. Places workpieces into furnace to preheat for specified time. Removes, tags or marks, and moves finished work. May attach grappling equipment to objects preparatory to movement by crane. May be designated according to type of activity as THERMAL-CUTTER HELPER (welding).

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*Dictionary of Occupational Titles, Fourth Edition, 1977.

TASK LISTING BY D.O.T. CODE

In this section the occupational exit points from the curriculum are cross referenced with the tasks which are required for employment in each job title. On the line following each task an x appears in the column of each job title to which to task applies. All the tasks listed in this matrix are taught in the curriculum presented in this guide. A detailed treatment of each task appears in the Unit Guides section of this curriculum guide.

TASK LISTING BY DOT CODE

METALS

MAJOR BLOCK - GENERAL METALS

POSSIBLE EXIT POINTS

	DOT DESCRIPTION	Lathe Operator	Sheet Metal Helper	Milling Machine Operator	Drill Press Operator	Sheet Metal Worker	Shielded-Metal Arc Welder	Oxyacetylene Welder	Brazer Assembler	Welder Helper
	DOT NO.	604.685-026	619.686-022	605.685-030	606.682-014	804.281-010	810.384-014	811.684-014	813.684-010	819.687-014
TASK NO.	TASK NAME									
	Duty A: Metallurgy									
GM-01	Identifying metal manufacturing processes	X	X	X	X	X	X	X	X	X
GM-02	Identifying the physical structure of metals	X	X	X	X	X	X	X	X	X
GM-03	Identifying properties of metals	X	X	X	X	X	X	X	X	X
GM-04	Identifying methods of heat treatment	X	X	X	X	X	X	X	X	X
GM-05	Identifying iron manufacturing processes	X	X	X	X	X	X	X	X	X
GM-06	Identifying processes used to produce steel	X	X	X	X	X	X	X	X	X
GM-07	Identifying processes used to produce copper,									
	brass and bronze alloys	X	X	X	X	X	X	X	X	X
GM-08	Identifying processes used to produce aluminum	X	X	X	X	X	X	X	X	X
GM-09	Identifying processes for the production of									
	magnesium and titanium	X	X	X	X	X	X	X	X	X
	Duty B: Bench Work									
GM-10	Laying out metal surfaces	X	X	X	X	X	X	X	X	X
GM-11	Identifying jig buttons	X	X	X	X	X	X	X	X	X
GM-12	Using the sine bar	X	X	X	X	X	X	X	X	X
GM-13	Using the bevel protractor	X	X	X	X	X	X	X	X	X
GM-14	Using steel rules	X	X	X	X	X	X	X	X	X
GM-15	Using the micrometer	X	X	X	X	X	X	X	X	X
GM-16	Reading a vernier scale	X	X	X	X	X	X	X	X	X
GM-17	Using dial indicators, center testers and									
	speed indicators	X	X	X	X	X	X	X	X	X

TASK LISTING BY DOT CODE

METALS

MAJOR BLOCK - GENERAL METALS

POSSIBLE EXIT POINTS

TASK NO.	TASK NAME / DOT DESCRIPTION	Lathe Operator	Sheet Metal Helper	Milling Machine Operator	Drill Press Operator	Sheet Metal Worker	Shielded-Metal Arc Welder	Oxyacetylene Welder	Brazer Assembler	Welder Helper
	DOT NO.	604.685-026	619.686-022	605.685-030	606.682-014	804.281-010	810.384-014	811.684-014	813.684-010	819.687-014
GM-18	Using precision gage blocks, tapered ring, plug and snap gages	X	X	X	X	X	X	X	X	X
GM-19	Identifying and using hand hacksaws	X	X	X	X	X	X	X	X	X
GM-20	Using abrasives and lapping compounds	X	X	X	X	X	X	X	X	X
GM-21	Identifying and using files	X	X	X	X	X	X	X	X	X
GM-22	Scraping flat and curved bearing surfaces	X	X	X	X	X	X	X	X	X
GM-23	Using hammers and screwdrivers for hand bench use	X	X	X	X	X	X	X	X	X
GM-24	Identifying and using wrenches	X	X	X	X	X	X	X	X	X
GM-25	Using bench vises and clamps	X	X	X	X	X	X	X	X	X
GM-26	Identifying and using chipping tools	X	X	X	X	X	X	X	X	X
GM-27	Using hand taps, dies and hand reamers	X	X	X	X	X	X	X	X	X
GM-28	Identifying power tool safety practices	X	X	X	X	X	X	X	X	X
GM-29	Assembling and fitting	X	X	X	X	X	X	X	X	X
GM-30	Identifying fasteners	X	X	X	X	X	X	X	X	X
GM-31	Using thread, center, fillet and radius gages	X	X	X	X	X	X	X	X	X
GM-32	Identifying lubricants and greases	X	X	X	X	X	X	X	X	X
GM-33	Performing machine maintenance	X	X	X	X	X	X	X	X	X
GM-34	Identifying bench work safety	X	X	X	X	X	X	X	X	X

TASK LISTING BY DOT CODE

METALS

MAJOR BLOCK: SHEET METAL

POSSIBLE EXIT POINTS

	DOT DESCRIPTION	Lathe Operator	Sheet Metal Helper	Milling Machine Operator	Drill Press Operator	Sheet Metal Worker	Shielded-Metal Arc Welder	Oxyacetylene Welder	Brazer Assembler	Welder Helper
	DOT NO.	604.685-026	619.686-022	605.685-030	606.682-014	804.281-010	810.384-014	811.684-014	813.684-010	819.687-014
TASK NO.	TASK NAME									
	Duty C: Metal Fabrication									
SM-01	Identifying materials used in sheet metalwork		X			X				
SM-02	Developing sheet metal patterns (stretchouts)					X				
SM-03	Cutting sheet metal		X			X				
SM-04	Bending sheet metal by hand					X				
SM-05	Bending metal on a bar folder or brake					X				
SM-06	Roll-forming sheet metal					X				
SM-07	Making seams					X				
SM-08	Using the rotary machine					X				
SM-09	Fastening sheet metal					X				
SM-10	Soft soldering sheet metal					X				

TASK LISTING BY DOT CODE

METALS

MAJOR BLOCK: WELDING

POSSIBLE EXIT POINTS

	DOT DESCRIPTION	Lathe Operator	Sheet Metal Helper	Milling Machine Operator	Drill Press Operator	Sheet Metal Worker	Shielded-Metal Arc Welder	Oxyacetylene Welder	Brazer Assembler	Welder Helper
	DOT NO.	604.685-026	619.686-022	605.685-030	606.682-014	804.281-010	810.384-014	811.684-014	813.684-010	819.687-014
TASK NO.	TASK NAME									
	Duty D: Foundations									
WL-01	Practicing safety					X	X	X	X	
WL-02	Identifying and using welding symbols					X	X	X	X	
WL-03	Using welding related shop tools and equipment					X	X	X	X	
WL-04	Identifying and preparing metals for welding					X	X	X	X	
WL-05	Measuring welding materials					X	X	X	X	
WL-06	Using clamps and jigs					X	X	X	X	
WL-07	Reading blueprints					X	X	X	X	
	Duty E: Oxyacetylene Welding, Cutting, Brazing and Soldering									
WL-08	Following safety procedures and regulations for oxyacetylene welding					X		X	X	X
WL-09	Using oxyacetylene cylinders and gases					X		X	X	X
WL-10	Inspecting oxygen and acetylene regulators					X		X	X	X
WL-11	Selecting and maintaining oxyacetylene torches and tips					X		X	X	X
WL-12	Setting up and lighting the oxyacetylene torch					X		X	X	X
WL-13	Carrying a puddle without a filler rod					X		X		
WL-14	Welding an outside corner joint without a filler rod using oxyacetylene equipment					X		X		

TASK LISTING BY DOT CODE

METALS

MAJOR BLOCK: WELDING

TASK NO.	TASK NAME	POSSIBLE EXIT POINTS								
	DOT DESCRIPTION	Lathe Operator	Sheet Metal Helper	Milling Machine Operator	Drill Press Operator	Sheet Metal Worker	Shielded-Metal Arc Welder	Oxyacetylene Welder	Brazer Assembler	Welder Helper
	DOT NO.	604.685-026	619.686-022	605.685-030	606.682-014	804.281-010	810.384-014	811.684-014	813.684-010	819.687-014
WL-15	Making beads with filler rods using oxyacetylene equipment					X		X		
WL-16	Welding butt joints using oxyacetylene equipment					X		X		
WL-17	Welding lap joints using oxyacetylene equipment					X		X	X	
WL-18	Welding T-joints using oxyacetylene equipment					X		X	X	
WL-19	Setting up the oxyacetylene apparatus for flame cutting					X		X	X	
WL-20	Cutting with an oxyacetylene cutting torch							X		
WL-21	Piercing and cutting holes using the oxyacetylene cutting torch							X		
WL-22	Cutting with an automatic oxyacetylene cutting machine							X		
WL-23	Welding beads with brass rods using oxyacetylene welding equipment					X		X	X	
WL-24	Brazing a lap joint using oxyacetylene apparatus					X		X	X	
WL-25	Brazing with silver using oxyacetylene equipment					X		X	X	
WL-26	Soldering					X			X	
WL-27	Welding cast iron using oxyacetylene apparatus							X	X	

TASK LISTING BY DOT CODE

METALS

MAJOR BLOCK: WELDING

POSSIBLE EXIT POINTS

TASK NO.	TASK NAME	Lathe Operator	Sheet Metal Helper	Milling Machine Operator	Drill Press Operator	Sheet Metal Worker	Shielded-Metal Arc Welder	Oxyacetylene Welder	Brazer Assembler	Welder Helper
	DOT NO.	604.685-026	619.686-022	605.685-030	606.682-014	804.281-010	810.384-014	811.684-014	813.684-010	819.687-014
WL-28	Cutting and welding pipe using oxyacetylene									
	apparatus							X		
	Duty F: Sheilded Arc Welding									
WL-29	Selecting and setting up shielded arc									
	welding apparatus						X			X
WL-30	Welding string and weave beads using shielded									
	arc welding apparatus						X			
WL-31	Arc welding string beads and padding a plate						X			
WL-32	Arc welding lap joints						X			
WL-33	Arc welding butt joints						X			
WL-34	Shielded arc welding T-fillet joints						X			
WL-35	Testing arc welded joints						X			
	Duty G: Inert Gas Welding									
WL-36	Identifying and describing tungsten inert gas									
	welding processes						X			
WL-37	Following safety procedures and regulations for									
	TIG welding						X			
WL-38	Identifying TIG welding equipment						X			
WL-39	Setting up TIG equipment to weld aluminum						X			
WL-40	Identifying and describing metal inert gas									
	(MIG) welding processes						X			

TASK LISTING BY DOT CODE

METALS

MAJOR BLOCK: WELDING

		POSSIBLE EXIT POINTS								
	DOT DESCRIPTION	Lathe Operator	Sheet Metal Helper	Milling Machine Operator	Drill Press Operator	Sheet Metal Worker	Shielded-Metal Arc Welder	Oxyacetylene Welder	Brazer Assembler	Welder Helper
	DOT NO.	604.685-026	619.686-022	605.685-030	606.682-014	804.281-010	810.384-014	811.684-014	813.684-010	819.687-014
TASK NO.	**TASK NAME**									
WL-41	MIG welding beads on mild steel plate						X			
WL-42	MIG welding butt joints using mild steel plate						X			
WL-43	MIG welding lap joints using mild steel plate						X			
WL-44	MIG welding fillet joints using mild steel plate						X			
WL-45	MIG welding with stainless steel						X			
WL-46	MIG welding with aluminum						X			

TASK LISTING BY DOT CODE

METALS

MAJOR BLOCK: MACHINE SHOP

POSSIBLE EXIT POINTS

TASK NO.	TASK NAME	Lathe Operator 604.685-026	Sheet Metal Helper 619.686-022	Milling Machine Operator 605.685-030	Drill Press Operator 606.682-014	Sheet Metal Worker 804.281-010	Shielded-Metal Arc Welder 810.384-014	Oxyacetylene Welder 811.684-014	Brazer Assembler 813.684-010	Welder Helper 819.687-014
	Duty H: Drilling Machine Work									
MS-01	Identifying parts and functions of the drilling machine				X	X				
MS-02	Identifying safety practices and precautions when using the drilling machine				X	X				
MS-03	Identifying work holding devices and set ups				X	X				
MS-04	Identifying and using drill bit holding devices				X	X				
MS-05	Identifying drill bits				X	X				
MS-06	Identifying cutting feeds and speeds				X	X				
MS-07	Identifying principles of straight drilling				X	X				
MS-08	Identifying and using coolants and cutting compounds				X	X				
MS-09	Grinding and care of drills				X	X				
MS-10	Identifying and using twist drill gages				X	X				
MS-11	Identifying and using drill grinding machines				X	X				
MS-12	Identifying machine reamers				X					
MS-13	Machine reaming				X					
MS-14	Identifying principles of boring and counter-boring				X					
MS-15	Spot facing				X					
MS-16	Countersinking, center drilling and tapping				X					

TASK LISTING BY DOT CODE

METALS

MAJOR BLOCK: MACHINE SHOP

POSSIBLE EXIT POINTS

	DOT DESCRIPTION	Lathe Operator	Sheet Metal Helper	Milling Machine Operator	Drill Press Operator	Sheet Metal Worker	Shielded-Metal Arc Welder	Oxyacetylene Welder	Brazer Assembler	Welder Helper
	DOT NO.	604.685-026	619.686-022	605.685-030	606.682-014	804.281-010	810.384-014	811.684-014	813.684-010	819.687-014
TASK NO.	TASK NAME									
	Duty I: Power Saw Work									
MS-17	Identifying power cut-off saws	X		X			X			X
MS-18	Identifying power saw safety	X		X			X			X
MS-19	Identifying and using work holding devices on the power cut-off saw	X		X			X			X
MS-20	Identifying, selecting, mounting and maintaining saw blades	X		X			X			
MS-21	Identifying speeds, feeds and coolants for power cut-off saws	X		X			X			
MS-22	Using the power cut-off saw for straight and angular sawing	X		X			X			X
MS-23	Identifying the metal band saw	X		X			X			X
MS-24	Identifying coolants and lubricating agents for band saws	X		X			X			
MS-25	Choosing saw blades for the metal band saw	X		X			X			
MS-26	Calculating feeds and speeds for the metal band saw	X		X			X			
	Duty J: Engine Lathe Work									
MS-27	Identifying lathe safety	X								
MS-28	Identifying lathes	X								
MS-29	Identifying work holding devices	X								
MS-30	Identifying cutting tools	X								

TASK LISTING BY DOT CODE

METALS

MAJOR BLOCK: MACHINE SHOP

POSSIBLE EXIT POINTS

TASK NO.	TASK NAME	Lathe Operator	Sheet Metal Helper	Milling Machine Operator	Drill Press Operator	Sheet Metal Worker	Shielded-Metal Arc Welder	Oxyacetylene Welder	Brazer Assembler	Welder Helper
	DOT DESCRIPTION / DOT NO.	604.685-026	619.686-022	605.685-030	606.682-014	804.281-010	810.384-014	811.684-014	813.684-010	819.687-014
MS-31	Identifying measuring tools	X								
MS-32	Identifying lathe attachments	X								
MS-33	Calculating cutting feeds and speeds on the									
	lathe	X								
MS-34	Determining RPM	X								
MS-35	Centering stock	X								
MS-36	Identifying principles of facing									
MS-37	Identifying principles of straight turning	X								
	and turning to shoulders	X								
MS-38	Identifying checks	X								
MS-39	Form turning	X								
MS-40	Identifying faceplate work	X								
MS-41	Using draw-in collets	X								
MS-42	Identifying principles of drilling	X								
MS-43	Identifying machine reamers	X								
MS-44	Reaming on the engine lathe	X								
MS-45	Boring on the engine lathe	X								
MS-46	Identifying and using mandrels	X								
MS-47	Knurling on the engine lathe	X								
MS-48	Cutting off on the engine lathe	X								
MS-49	Identifying thread cutting devices	X								
MS-50	Identifying the parts of a thread	X								
MS-51	Identifying American National Thread standards	X								

TASK LISTING BY DOT CODE

METALS

MAJOR BLOCK: MACHINE SHOP

POSSIBLE EXIT POINTS

	DOT DESCRIPTION	Lathe Operator	Sheet Metal Helper	Milling Machine Operator	Drill Press Operator	Sheet Metal Worker	Shielded-Metal Arc Welder	Oxyacetylene Welder	Brazer Assembler	Welder Helper
	DOT NO.	604.685-026	619.686-022	605.685-030	606.682-014	804.281-010	810.384-014	811.684-014	813.684-010	819.687-014
TASK NO.	TASK NAME									
MS-52	Computing American National Thread form	X								
MS-53	Computing sharp V-thread formulas	X								
MS-54	Identifying Acme threads	X								
MS-55	Using the Acme tap	X								
MS-56	Identifying square threads	X								
MS-57	Identifying classes of fits of screw threads	X								
MS-58	Using thread gages	X								
MS-59	Using a thread micrometer	X								
MS-60	Measuring threads with the three-wire method	X								
MS-61	Cutting threads with an even geared lathe	X								
MS-62	Cutting threads on a lathe which is not even geared	X								
MS-63	Cutting threads on a quick-change gear lathe	X								
MS-64	Identifying multiple lead screw threads	X								
MS-65	Cutting left hand threads	X								
MS-66	Determining a tap drill size	X								
MS-67	Cutting interval threads and tapping	X								
MS-68	Identifying principles of taper turning	X								
MS-69	Computing tapers	X								
MS-70	Measuring short tapers	X								
MS-71	Gaging inside and outside tapers	X								
MS-72	Tapering by the offset tail stock methods	X								
MS-73	Cutting a taper with the compound rest	X								

TASK LISTING BY DOT CODE

METALS

MAJOR BLOCK: MACHINE SHOP

	POSSIBLE EXIT POINTS DOT DESCRIPTION	Lathe Operator	Sheet Metal Helper	Milling Machine Operator	Drill Press Operator	Sheet Metal Worker	Shielded-Metal Arc Welder	Oxyacetylene Welder	Brazer Assembler	Welder Helper
	DOT NO.	604.685-026	619.686-022	605.685-030	606.682-014	804.281-010	810.384-014	811.684-014	813.684-010	819.687-014
TASK NO.	TASK NAME									
MS-74	Cutting a taper with the taper attachment	X								
MS-75	Boring or turning interval tapers	X								
MS-76	Identifying coolants and cutting compounds	X								
MS-77	Identifying lubricants	X								
	Duty K: Milling Machine Work									
MS-78	Identifying types, sizes, construction, specifications, nomenclature and range of work for milling machines			X						
MS-79	Identifying milling machine work holding devices and their functions			X						
MS-80	Identifying, selecting and aligning milling machine attachments			X						
MS-81	Selecting and setting up milling machine cutters and holders			X						
MS-82	Calculating cutting speeds and feeds for milling machine work			X						
MS-83	Performing a plain milling operation			X						
MS-84	Performing a face milling operation			X						
MS-85	Performing a side milling operation			X						
MS-86	Performing a form milling operation			X						
MS-87	Performing an angular milling operation			X						
MS-88	Performing an end milling operation			X						

TASK LISTING BY DOT CODE

METALS

MAJOR BLOCK: MACHINE SHOP

		POSSIBLE EXIT POINTS								
	DOT DESCRIPTION	Lathe Operator	Sheet Metal Helper	Milling Machine Operator	Drill Press Operator	Sheet Metal Worker	Shielded-Metal Arc Welder	Oxyacetylene Welder	Brazer Assembler	Welder Helper
TASK NO.	**TASK NAME** / DOT NO.	604.685-026	619.686-022	605.685-030	606.682-014	804.281-010	810.384-014	811.684-014	813.684-010	819.687-014
MS-89	Drilling, boring and reaming with the milling machine			X						
MS-90	Performing sawing, slitting and cutting off operations with the milling machine			X						
MS-91	Performing keyseating and T-slot milling operations			X						
MS-92	Performing indexing operations			X						
MS-93	Performing circular milling operations			X						
MS-94	Performing graduating and marking operations			X						
MS-95	Performing profiling			X						
MS-96	Maintaining and caring for the milling machine			X						

PERFORMANCE STANDARDS REQUIRED FOR GRADUATION

Students are required, by the State Board of Education to demonstrate competency in the adult life roles of the learner, individual, citizen, consumer and producer. The performance standards for the adult life role of the learner will be measured statewide. The local Boards of Education are required to adopt and validate performance indicators for the adult life roles of the individual, citizen, consumer and producer.

Performance Standards (State Board of Education)

A. Learner

1. The student reads and interprets communication on a functional level.
2. The student comprehends information received and applies that information in a variety of everyday situations.
3. The student writes legible appropriate personal and career communications on a functional level.
4. The student receives and transmits oral and visual communications on a functional level.
5. The student employs estimation, approximation and calculation skills in everyday living situations.
6. The student understands and uses various forms of scales and measurements, graphs, charts, tables, symbols and other graphic representations.
7. The student applies basic arithmetic operations (adding, subtracting, multiplying and dividing) in an everyday context.
8. The student applies basic geometric shapes and positions necessary for daily mathematical functions.
9. The student uses a variety of information resources to obtain assistance and information.
10. The student employs logical, intuitive and creative thinking processes.

Performance Standards (Local Board of Education)

B. Individual

1. The student knows appropriate emergency responses to accidents and demonstrates preventive actions for health and safety hazards.

2. The student recognizes and practices sound personal health habits necessary to maintain physical and mental well-being.

3. The student understands the sound health care principles involved in family living, parenting and parenthood.

C. Citizen

1. The student understands the basic structure and functions of the American system of Government and the American economic system.

2. The student knows basic legal rights and responsibilities of the citizen under the American judicial and penal systems.

3. The student recognizes relationships between current societal and environmental problems and the individual's role and responsibilities.

D. Consumer

1. The student knows the principles of sound personal financial planning and management.

2. The student identifies the legal rights and responsibilities of the consumer in buying and selling goods and services.

E. Producer

1. The student analyzes personal career opportunities and choices through career planning and management.

2. The student demonstrates the skills necessary to obtain employment.

Program Competencies

This program will provide opportunities for the student to demonstrate competencies in the following performance standards. The standards are "keyed" to the above list by letter and number (i.e. A-1, 4, 9; B-3; C-1; etc.).

Performance Standards:

A-1, A-2, A-3, A-4, A-6, A-7, A-8, A-9, A-10; B-1, B-2; E-1, E-2

SECTION III

UNIT GUIDES

SECTION III

Section III Content List

Unit Guide Description
List of Drafting Tools and Equipment
Suggested Sequence of Unit Guides

In Section II, the relationship between the occupational area and program tasks was introduced. Section III continues this development by presenting, for each task, a unit guide for instructional planning and execution.

The instruction of specific tasks is central to vocational education. However, the value of a single task/competency to the student as a prospective member of the workforce is dependent upon the way in which that task/competency is related to other tasks and to the entire occupational area. Therefore, the Metals Cluster Program Task Listing provides a sample organizational model for sequencing the instruction of program tasks.

UNIT GUIDES DESCRIPTION

In this section the tasks to be taught in each block are presented in sequential order. Each task is listed on a separate page so that it may be taken out of the guide for daily lesson planning or regrouped with other tasks to fit the individual teacher's preference for teaching order. The task pages may be used for planning and executing group instruction or for individualized instruction.

Each page in the UNIT GUIDES section contains the following information:

TASK: This is a short and concise statement of the task to be taught.

PERFORMANCE OBJECTIVE: The performance expected of the student after completing the unit is stated in stem form, without a specific statement of all conditions, equipment and performance standard (these are listed in a criterion referenced measure in the Evaluation section of the task page).

INSTRUCTIONAL ACTIVITIES: Suggested learning activities are presented. These activities include providing information, demonstration, practical applications and projects.

INSTRUCTIONAL MATERIALS: Suggested materials for carrying out the instructional activities are listed. These include textbooks, audiovisuals and equipment. Textbooks are referenced by author and/or title with the complete reference contained in the textbook list in the Instructional Resources section (Appendix A).

EVALUATION: This section contains a criterion referenced measure and reference to any test items or other evaluation measures that are available to teacher.

CLASSROOM HOURS: The ESTIMATED time for completing the instructional activities and the evaluation are provided in the classroom hours section. These suggested hours are the TOTAL instructional time which includes both classroom and laboratory activities. The instructor must use his/her judgment in determining the percentage of total time spent in the classroom and lab.

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TASK

GM-01 Identifying metal manufacturing processes

PERFORMANCE OBJECTIVE

Identify metal manufacturing processes.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Methods of casting
   1. Sand
   2. Centrifugal
   3. Permanent-mold
   4. Die
b. Permanent-mold casting
c. Centrigugal casting
   1. Application
   2. Procedure
d. Die casting
   1. Hot chamber
   2. Cold chamber
e. Die forging
f. Extrusion
   1. Procedure
   2. Advantages
g. Cold forging steel
   1. Upsetting or heading
   2. Header
   3. Applications
h. Processing metal powders
   1. Electroforming
   2. Powder metallurgy
   3. Metal powder products
i. Stretching, shearing, bending
j. Wire drawing
   1. Material used
   2. Pickling
   3. Sulling

INSTRUCTIONAL MATERIALS

Textbooks:

Kibbe

A/Vs:

Bergwall, filmstrip #506,
"Foundry Work"

Tools and Equipment:

Display of various metals
after treatment

CLASSROOM HOURS 5

EVALUATION (GM-01)

a. Given a specified metal manufacturing process, the student will identify the process, describe the steps in the process and identify the purpose of the process in terms of products.

b. Bergwall, Study Guide, filmstrip questions.

TASK

GM-02 Identifying the physical structure of metals

PERFORMANCE OBJECTIVE

Define and identify the physical structure of metals.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Definition of a metal
   1. Lustrous appearance
   2. Conductivity
   3. Number of metals in existence

b. Metallurgy
   1. Ores
   2. Chemical metallurgy
   3. Physical metallurgy

c. Properties of metals
   1. Strength
   2. Malleability
   3. Ductility
   4. Toughness
   5. Elasticity
   6. Ferromagnetic
   7. Thermocouple

d. Metal point of metals
   1. Definition
   2. Latent heat of fusion

e. Arrangement of atoms in metals
   1. Space lattice of geometric crystal structure
   2. Hexagonal close packed space lattice

f. Crystal formation

g. Composition of alloys

h. Nonferrous alloys

i. Cadmium

j. Cobalt

k. How metals are cast

l. Metal working

m. How metals are joined

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part II

b. Kibbe

Student Manuals:

Ohio, Machine Trades II, Metallurgy Assignment Sheet #1

Tools and Equipment:

a. Different types of metals

b. Metal ores

CLASSROOM HOURS

5

EVALUATION (GM-02)

a. Given a metal, the student will correctly identify its physical structure in terms of appearance, conductivity, malleability and melting point. This must be done with one hundred percent accuracy.

b. Ohio, Machine Trades II, Instructor Manual.

TASK

GM-03 Identifying properties of metals

PERFORMANCE OBJECTIVE

Identify properties of metals.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Mechanical properties
    1. Hardness
    2. Ductility
    3. Machinability
    4. Tensile strength
b. Stress
c. Kinds of stress
    1. Tension
    2. Compression
    3. Shear
d. Elasticity
    1. Elastic limit
    2. Ultimate breaking strength
e. Strain
f. Metal fatigue

(Continued on back)

Provide Demonstration On:

Figuring tensile strength

Provide Practical Application On:

Figure tensile strength of selected metals.

INSTRUCTIONAL MATERIALS

Textbooks:

Burghardt, Part II

Student Manuals:

Ohio, Machine Trades II, Metallurgy Assignment Sheet #2

Tools and Equipment:

a. Tensile strength tester
b. Brinnel hardness tester
c. Shear strength tester

CLASSROOM HOURS 10

EVALUATION (GM-03)

Given a metal, the student will correctly identify its basic properties and figure tensile strength for a specified area and force. This must be done with one hundred percent accuracy.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

g. Causes of failure
    1. Elastic breakdown
    2. Creep failures
h. Usable strength of metal
i. Heat and temperature
    1. Friction
    2. Motion of molecules
    3. Transfer of heat
    4. Heat and cold
j. Expansion of metals
k. Density
l. Specific gravity

TASK

GM-04 Identifying methods of heat treatment

PERFORMANCE OBJECTIVE

Identify methods used to heat treat metals.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Metallurgy and heat treatment
b. Principles of heat treating
c. Equilibrium diagrams
d. Transformation of temperatures
e. Iron-carbon phase diagram
    1. Liquidous line
    2. Solidous line
    3. Eutectic point
    4. Austenite
    5. Delta ferrite
    6. Alpha ferrite
    7. Eutectoid
    8. Pearlite
f. Effects of heating, holding, cooling
g. Isothermal transformation
    1. S-curve or TTT diagram
    2. Pearlite
    3. Bainite
    4. Martensite
h. Heat treating ferrous metals
    1. Hardening
    2. Tempering
    3. Annealing
    4. Normalizing
    5. Spheroidizing
    6. Casehardening

INSTRUCTIONAL MATERIALS

Textbooks:

Burghardt, Part II

Student Manuals:

Ohio, Machine Trades II, Heat Treating Assignment Sheets #1-11

Tools and Equipment:

Various gears, shafts, etc. that have been heat treated

CLASSROOM HOURS

10

EVALUATION (GM-04)

a. Given a specified heat treatment process for metals, the student will identify and describe the process in terms of the properties of the metal.

b. Ohio, Machine Trades II, Instructor Manual.

c. V'TECS, Machine Shop, Task No. 30.

TASK

GM-05 Identifying iron manufacturing processes

PERFORMANCE OBJECTIVE

Identify processes used to produce iron.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Iron ore
b. Making pig iron
    1. Pigs
    2. Pig molds
    3. Smelting
    4. Reduction
    5. Charging the blast furnace
c. Making cast iron
    1. Categories of iron-carbon alloys
    2. Elements in cast iron
    3. Advantages of cast iron
    4. Cupola
    5. Cementite
d. Gray cast iron
    1. Characteristics
    2. Applications
e. White cast iron
    1. Characteristics
    2. Applications
f. Malleable cast iron
    1. Characteristics
    2. Applications
g. Ductile cast iron
    1. Characteristics
    2. Applications
h. Producing steel from iron
    1. Open-hearth process
    2. The Bessemer process
    3. Basic oxygen process
    4. Electric furnace process

INSTRUCTIONAL MATERIALS

Textbooks:

Burghardt, Part II

Student Manuals:

Ohio, Machine Trades II, Metallurgy Assignment Sheets #3, 4

Tools and Equipment:

a. Examples of iron
b. Milling machine and attachments
c. American Machinist's Handbook

CLASSROOM HOURS 10

EVALUATION (GM-05)

a. Given specifications for a type of iron and steel, the student will identify and describe the processes used to produce the iron and steel.

b. Ohio, Machine Trades II, Instructor Manual.

TASK

GM-06 Identifying processes used to produce steel

PERFORMANCE OBJECTIVE

Identify processes used to produce steel.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Carbon steels
   1. Points
   2. Low carbon steel
   3. Medium carbon steel
   4. High carbon steel

b. Rolling steel
   1. Ingots
   2. Blooms, billets on slabs

c. Steel forms
   1. Plate
   2. Sheet
   3. Strip
   4. Bars
   5. Hot-rolled
   6. Cold-drawn
   7. Cast

(Continued on back)

Provide Demonstration On:

Identifying steel codes

Provide Practical Application On:

Identify the type of steel given and its code.

INSTRUCTIONAL MATERIALS

Textbooks:

Burghardt, Part II

Student Manuals:

Ohio, Machine Trades II, Metallurgy Assignment Sheets #6-13

Tools and Equipment:

a. American Machinist's Handbook
b. Examples of steels

CLASSROOM HOURS

10

EVALUATION (GM-06)

Given a piece of steel which is coded, the student will identify the code, describe the process used to produce the steel and identify the application of the steel according to the instructor's specifications.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

d. Hot-rolled steel sheet
    1. Commercial quality (CQ)
    2. Drawing quality (DQ)
    3. Physical quality (PQ)
e. Cold-rolled carbon steel strips
f. Hot-rolled carbon steel strips
g. Carbon steel plates
h. Carbon steel bars
i. Structural steel
j. Constructional grade and tool steels
k. Stainless steel
    1. Austenitic
    2. Ferritic
    3. Martensitic
l. Alloy steels
m. Steel classification
    1. SAE
    2. AISI
n. Steel color codes

TASK

GM-07 Identifying processes used to produce copper, brass and bronze alloys

PERFORMANCE OBJECTIVE

Identify processes used to produce copper, brass and bronze alloys.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Producing copper
   1. Ores
   2. Separating ore
   3. Blister copper
   4. Anodes
   5. Cathodes
b. Copper alloys
   1. Silver
   2. Boron
   3. Lithium
c. Machinability ratings
   1. Adding lead
   2. Naval brass
   3. Red brass
d. Electrical conductivity
e. Corrosion resistance
f. Annealing copper
g. Brass
   1. Yellow (cartridge)
   2. Muntz metal
   3. Admirality brass
   4. Bronze
h. Phosphor bronze alloys
i. Nickel silver
j. Aluminum bronze
k. Other bronzes
   1. Manganese
   2. Silicon
   3. Bull bronze
   4. Nickel bronze
l. Berryllium copper
m. Cupro-nickel
n. Copper-alloy casting

INSTRUCTIONAL MATERIALS

Textbooks:

Burghardt, Part II

Student Manuals:

Ohio, Machine Trades II, Metallurgy Assignment Sheet #14

Tools and Equipment:

a. Examples of copper and alloys
b. American Machinist's Handbook

CLASSROOM HOURS

10

EVALUATION (GM-07)

a. Given specifications for copper and its alloys, the student will identify the type of copper or alloy and describe the process used to produce the metal.

b. Ohio, Machine Trades II, Instructor Manual.

TASK

GM-08 Identifying processes used to produce aluminum

PERFORMANCE OBJECTIVE

Identify processes used to produce aluminum.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Properties of aluminum
   1. Low density
   2. High strength
   3. Electrical conductor (EC) grade
   4. Easy to fabricate
   5. Non-magnetic and non-sparking
b. Production of aluminum
c. Aluminum based alloys
   1. Wrought grades
   2. Casting grades
d. Wrought aluminum grades
   1. Aluminum association designation system
   2. Temper designation
e. Aluminum casting grades
   1. Aluminum association system
   2. Codes for heat-treatable casting alloys
f. Alloying elements
   1. Copper
   2. Silicon
   3. Magnesium
   4. Non-impurities
   5. Zinc, nickel and tin
g. Forming processes
   1. Forging
   2. Powder metallurgy
   3. Cladding
h. Anodizing
   1. Purpose
   2. Industrial applications

INSTRUCTIONAL MATERIALS

Textbooks:

Burghardt, Part II

Student Manuals:

Ohio, Machine Trades II, Metallurgy Assignment Sheet #15

Tools and Equipment:

a. Examples of aluminum
b. American Machinist's Handbook

CLASSROOM HOURS

10

EVALUATION (GM-08)

a. Given a section of aluminum, the student will identify the type and describe the process used to produce it.

b. Ohio, Machine Trades II, Instructor Manual.

TASK

GM-09 Identifying processes for the production of magnesium and titanium

PERFORMANCE OBJECTIVE

Identify the process for the production of magnesium and titanium.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Production of magnesium
    1. Magnesium fluoride
    2. Magnesite
    3. Dolomite
    4. Carnallite
b. Extraction of magnesium
    1. Electrolytic method
    2. Carbothermic method
c. Alloying, melting and refining magnesium
d. Alloying magnesium
e. Magnesium alloy designations
f. Magnesium casting alloys
    1. Magnesium-aluminum-manganese (AM)
    2. Magnesium-aluminum zinc (AZ)
    3. Magnesium-rare earth-zirconium (EK, EZ and ZE)
    4. Magnesium-zinc-zirconium (ZK)
    5. Magnesium-thorium-zirconium (HK, HZ and ZH)
g. Magnesium wrought alloys
h. Extrusion
i. Rolling
j. Forming
k. Machining
l. Magnesium fires and safety

INSTRUCTIONAL MATERIALS

Textbooks:

Kibbe

Student Manuals:

Ohio, Machine Trades II, Metallurgy Assignment Sheet #16

CLASSROOM HOURS

10

EVALUATION (GM-09)

a. Given a specification for magnesium, titanium or an alloy, the student will identify the metal, describe the process used to refine it and identify procedures used to join the metal. The completed task must meet the instructor's specifications.

b. Ohio, Machine Trades II, Instructor Manual.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

m. Joining magnesium
   1. Welds, rivets, bolts or screws
   2. TIG welding and MIG welding
n. Titanium
   1. Processing
   2. Commercially pure titanium
   3. Uses of titanium

TASK

GM-10 Laying out metal surfaces

PERFORMANCE OBJECTIVE

Layout a metal surface by marking or scribing center points, circles, arc or straight lines.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Tools used for laying out and scribing lines
b. Scribers
  1. Construction
  2. Keeping the point sharp
c. Kinds of mixtures which produce a white coating
d. Copper sulphate solution
e. Bluing a steel surface
f. Cleanliness
g. Laying out angular lines
h. Grinding points of punches
  1. Center punch
  2. Prick punch
i. Using dividers

(Continued on back)

Provide Demonstration On:

a. Marking a metal surface
b. Scribing a metal surface
c. Locating the center point on round stock

Provide Practical Application On:

a. Use a scriber to mark a circle, arc and straight line on a metal surface.
b. Locate and mark the center point on round stock.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Porter

A/VS:

a. Bergwall, filmstrip #505, "Bench Metal Work"
b. Prentice-Hall, filmstrip #VD930-1, "Machine Shop: Bench Operations"

Student Manuals:

a. Georgia, Metal Fabrication Cluster, PLACE Package Title No. BSMO-1
b. Ohio, Machine Trades I, Bench Work Assignment Sheet #1

Tools and Equipment:

a. Scribing tools
b. Marking supplies

(Continued on back)

CLASSROOM HOURS

12

EVALUATION (GM-10)

a. Given appropriate tools, supplies and equipment, the student will accurately lay out metal work by scribing or marking circles, arcs and straight lines and marking the center point of round stock.

b. V'TECS, Machine Shop, Task No. 22.

c. Georgia, Metal Fabrication Cluster, Teachers Edition.

d. Bergwall, Study Guide, filmstrip questions.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

j. Surface plate
k. Use of Vee blocks
l. Centering round stock
    1. Methods
    2. Tools used

INSTRUCTIONAL MATERIALS

Tools and Equipment:

c. American Machinist's Handbook
d. Machinery's Handbook

TASK

GM-11 Identifying jig buttons

PERFORMANCE OBJECTIVE

Identify the purpose of jig buttons and the method of spacing holes in circles.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Jig buttons
   1. Purpose
   2. Location on the work
   3. Instruments used to set buttons
   4. Tightening the screws
b. Using the parallel and micrometer
c. Using the height gage
d. When jig buttons are removed
e. Lay out equally spaced holes on a circle

Provide Demonstration On:

a. Setting jig buttons
b. Laying out equally spaced holes on a circle

Provide Practical Application On:

a. Locate and set jig buttons.
b. Lay out equally spaced holes on a circle.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe

Student Manuals:

Ohio, Machine Trades I, Bench Work Assignment Sheet #2

Tools and Equipment:

a. American Machinist's Handbook
b. Jig button
c. Screw
d. Washer
e. Parallel
f. Micrometer
g. Height gage

CLASSROOM HOURS

4

EVALUATION (GM-11)

Given appropriate tools, supplies and equipment, the student will lay out and correctly set jig buttons and accurately lay out equally spaced holes in a given size circle.

TASK

GM-12 Using the sine bar

PERFORMANCE OBJECTIVE

Use the sine bar to check angles, bevels and tapers pertaining to templates, gauges and other angular work.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Sine bar
    1. Purpose
    2. Method
    3. Construction (kind of steel)
b. Sine bar application
    1. Items that can be checked
    2. Jo-block
c. Trigonometric functions
    1. Formula
    2. Right triangle
d. Adjustable angle plates

Provide Demonstration On:

a. Using the trigonometry formula for setting the sine bar
b. Measuring an angle with the sine bar

Provide Practical Application On:

a. Sketch a surface plate with a two inch Jo-block and an angle plate mounted with a five inch sine bar.
b. Measure an angle using the sine bar.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Porter

A/Vs:

Bergwall, filmstrip #503-5, "Measuring Tools Explained"

Student Manuals:

a. Ohio, Machine Trades I, Bench Work Assignment Sheet #3
b. Machine Shop Training Course, Vol. 1

Tools and Equipment:

a. American Machinist's Handbook
b. Machinery's Handbook
c. Sine bar
d. Jo-blocks

CLASSROOM HOURS

4

EVALUATION (GM-12)

a. Given an assigned measurement, the student will accurately measure an angle using the sine bar. The instructor will check the student's results for accuracy.

b. V'TECS, Machine Shop, Task No. 40.

c. Bergwall, Study Guide, filmstrip questions.

TASK

GM-13 Using the bevel protractor

PERFORMANCE OBJECTIVE

Use a bevel protractor to make an assigned relative measurement.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Bevel protractor
   1. Application
   2. Maximum revolution
   3. Valve of the divisions on the vernier scale
   4. Maximum reading on the scale

b. Measuring angles greater than 90°

Provide Demonstration On:

a. Reading the scale on a bevel protractor

b. Making a greater than 90° measurement

Provide Practical Application On:

a. Measure an angle and read the scale on the bevel protractor.

b. Measure an angle which is greater than 90°.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I

b. Kibbe

c. Porter

A/Vs:

Bergwall, filmstrip #503
"Measuring Tools Explained"

Student Manuals:

Ohio, Machine Trades I, Bench Work Assignment Sheet #4

Tools and Equipment:

Bevel protractor

CLASSROOM HOURS

4

EVALUATION (GM-13)

a. Given a bevel protractor and an assigned measurement, the student will be able to accurately read the measurement. The measurement may be of an angle which is greater than 90°.

b. Bergwall, Study Guide, filmstrip questions.

TASK

GM-14 Using steel rules

PERFORMANCE OBJECTIVE

Use steel rules to make measurements.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types of steel rules
b. Types of scales on the rule
c. Reading the scale
d. Using a short length rule
e. Adding fractions
f. Reducing a fraction to lowest terms

Provide Demonstration On:

a. Using a short length rule
b. Adding fractions
c. Reducing fractions to lowest terms

Provide Practical Application On:

Use a steel rule to make an assigned measurement.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

A/Vs:

a. Bergwall, filmstrip #505-1, "Bench Metal Work"
b. Prentice-Hall, filmstrip #VD930-1, "Machine Shop: Bench Operations"

Student Manuals:

Ohio, Machine Trades I, Bench Work Assignment Sheet #5

Tools and Equipment:

Steel ruler

CLASSROOM HOURS 2

EVALUATION (GM-14)

a. Given a steel rule and an assigned measurement, the student will be able to make the measurement to an accuracy of 1/64 inch and reduce the fractional reading to lowest terms. The instructor will check the student's reading.

b. Bergwall, Study Guide, filmstrip questions.

93

TASK

GM-15 Using the micrometer

PERFORMANCE OBJECTIVE

Use the micrometer.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types of micrometers
    1. Screw thread micrometer
    2. Outside micrometer
    3. Inside micrometer
    4. Micrometer depth gages
b. Care and maintenance of micrometers
c. Using micrometers
d. Temperature factors
e. Parts of a standard micrometer

Provide Demonstration On:

Using a micrometer to measure outside diameter, inside diameter

Provide Practical Application On:

Name the standard parts of a micrometer.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

A/Vs:

Bergwall, filmstrip #503-2, 3, 4, "Measuring Tools Explained"

Student Manuals:

a. Georgia, Metal Fabrication Cluster, PLACE Package Title No. M-1 through M-7
b. Ohio, Machine Trades I, Bench Work Assignment Sheet #6

Tools and Equipment:

Micrometer

CLASSROOM HOURS

4

EVALUATION (GM-15)

a. Given a micrometer and an assigned measurement, the student will be able to read a measurement to an accuracy of three places. The student will be able to identify and choose the appropriate micrometer to measure inside diameter, outside diameter, screw threads and depths.

b. V'TECS, Machine Shop, Task No. 19.

c. Georgia, Metal Fabrication Cluster, Teachers Edition.

d. Bergwall, Study Guide, filmstrip questions.

TASK

GM-16 Reading a vernier scale

PERFORMANCE OBJECTIVE

Read a vernier scale as applied to calipers and micrometers.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Divisions of the vernier scale
b. Reading a scale
c. Reading a vernier micrometer
    1. Vernier reading
    2. Thimble reading

Provide Demonstration On:

a. Reading a vernier caliper
b. Reading a vernier micrometer

Provide Practical Application On:

Make assigned measurements with a vernier caliper and a vernier micrometer.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

A/Vs:

Bergwall, filmstrip #503-1, "Measuring Tools Explained"

Student Manuals:

a. Georgia, Metal Fabrication Cluster, PLACE Package Title No. MV-1 through MV-5
b. Ohio, Machine Trades I, Bench Work Assignment Sheet #7

Tools and Equipment:

a. Calipers (vernier)
b. Micrometers (vernier)

CLASSROOM HOURS

4

EVALUATION (GM-16)

a. Given a vernier caliper and a vernier micrometer, the student will be able to make assigned measurements and read the scales to an accuracy of four places.

b. Georgia, Metal Fabrication Cluster, Teachers Edition.

c. Bergwall, Study Guide, filmstrip questions.

TASK

GM-17 Using dial indicators, center testers and speed indicators

PERFORMANCE OBJECTIVE

Use a dial indicator, center tester and speed indicator in bench work to set up and inspect work for roundness, concentricity, straight and parallel surfaces.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Dial indicators
b. Center testers
c. Speed indicators
d. The center punch mark
e. Types of graduations found on a dial indicator

Provide Demonstration On:

a. Using a dial indicator
b. Using a center tester
c. Using a speed indicator

Provide Practical Application On:

Use a dial indicator, center tester and speed indicator to set up and inspect work for roundness, concentricity, straight and parallel surfaces.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

A/Vs:

Bergwall, filmstrip #503-5, "Measuring Tools Explained"

Student Manuals:

a. Ohio, Machine Trades I, Bench Work Assignment Sheet #8
b. Machine Shop Training Course, Vol. I

Tools and Equipment:

a. American Machinist's Handbook
b. Dial indicators
c. Wigglers on center finders
d. Speed indicators

CLASSROOM HOURS

4

EVALUATION (GM-17)

a. Given a dial indicator, center tester and speed indicator, the student will use these instruments correctly to set up and inspect work for roundness, concentricity, straight and parallel surfaces.

b. V'TECS, Machine Shop, Task No. 36.

c. Bergwall, Study Guide, filmstrip questions.

TASK

GM-18 Using precision gage blocks, tapered ring, plug and snap gages

PERFORMANCE OBJECTIVE

Use precision gage blocks, tapered ring, plug and snap gages.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Gage blocks
   1. Description
   2. Uses
   3. Sizes
b. Using gage block combinations
c. Using gage blocks to check micrometer accuracy
d. Using a taper gage (figuring the taper)
e. Using a snap gage
   1. Sizes
   2. Tolerance

Provide Demonstration On:

a. Using gage blocks
b. Using a taper gage
c. Using plug and snap gages

Provide Practical Application On:

a. Use a combination of gage blocks to check a measurement for accuracy.
b. Use a taper gage to calculate taper.
c. Use plug and snap gages to measure a given dimension.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

A/Vs:

Bergwall, filmstrip #503-4, "Measuring Tools Explained"

Student Manuals:

a. Ohio, Machine Trades I, Bench Work Assignment Sheet #9
b. Machine Shop Training Course, Vol. I

Tools and Equipment:

a. Precision gage blocks
b. Tapered ring gage
c. Plug and snap gages
d. American Machinist's Handbook
e. Micrometer

CLASSROOM HOURS

4

EVALUATION (GM-18)

a. Given an assigned series of measurements, the student will be able to properly use gage blocks, a tapered gage and plug and snap gages to make accurate measurements according to proper procedure.

b. V'TECS, Machine Shop, Task No. 37 and 38.

c. Bergwall, Study Guide, filmstrip questions.

TASK

GM-19 Identifying and using hand hacksaws

PERFORMANCE OBJECTIVE

Identify and be able to use hand hacksaws including types and sizes of blades.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Testing a material with a file prior to sawing
b. Saw blades
    1. Teeth-per-inch
    2. Types
    3. Tightening a blade
    4. Types, sizes
c. Using the vise (Using pieces of wood for chips, pieces)
d. Layout line

Provide Demonstration On:

a. Installing a hacksaw blade
b. Using a hacksaw

Provide Practical Application On:

Choose a hacksaw blade, install it on a saw and cut an assigned piece of material.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

A/Vs:

a. Bergwall, filmstrip #505-2, "Bench Metal Work"
b. Prentice-Hall, filmstrip #VD930-2, "Machine Shop: Bench Operations"

Student Manuals:

Ohio, Machine Trades I, Bench Work Assignment Sheet #10

Tools and Equipment:

a. Machinist's Handbook
b. Hacksaw
c. Vise
d. Hacksaw blades

CLASSROOM HOURS

4

EVALUATION (GM-19)

a. Given a hacksaw and a selection of blades, the student will be able to select and install the appropriate blade to cut an assigned piece of metal and cut the metal to a specified dimension using appropriate hand hacksaw procedure.

b. V'TECS, Machine Shop, Task No. 28 and No. 41.

c. Bergwall, Study Guide, filmstrip questions.

TASK

GM-20 Using abrasives and lapping compounds

PERFORMANCE OBJECTIVE

Use abrasives and lapping compounds to obtain a fine, smooth surface on hard or soft metal.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Abrasives
    1. Natural types
    2. Manufactured types
b. Laps of soft materials
c. Materials used for laps
d. Scoring or grooving laps
    1. Purpose
    2. Procedure
e. Lapping flat surfaces
f. Emery cloth
g. Buffing

Provide Demonstration On:

a. Lapping a surface
b. Smoothing a surface using emery cloth

Provide Practical Application On:

a. Lap a surface.
b. Use emery cloth to smooth a metal surface.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

A/Vs:

Bergwall, filmstrip #501, "The Lathe Explained"

Student Manuals:

Ohio, Machine Trades I, Bench Work Assignment Sheet #11

Tools and Equipment:

a. American Machinist's Handbook
b. Machinery's Handbook
c. Emery cloth
d. Lapping compound
e. Vise

CLASSROOM HOURS 4

EVALUATION (GM-20)

a. Given a soft or hard metal surface, the student will be able to obtain a fine and smooth surface using abrasives and lapping compound.

b. Bergwall, Study Guide, filmstrip questions.

TASK

GM-21 Identifying and using files

PERFORMANCE OBJECTIVE

Identify and use files.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Single cut files
b. File teeth
c. File faces
d. 1/2 round files
e. The parts of a file
f. Double cut files

Provide Demonstration On:

Using a file

Provide Practical Application On:

Use a file on given material.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

A/Vs:

a. Bergwall, filmstrip #505-3, "Bench Metal Work"
b. Prentice-Hall, filmstrip #VD930-2, "Machine Shop: Bench Operations"

Student Manuals:

Ohio, Machine Trades I, Bench Work Assignment Sheet #12

Tools and Equipment:

Files

CLASSROOM HOURS

4

EVALUATION (GM-21)

a. Given a piece of metal with a rough edge, the student will be able to correctly select a file and smooth the edge following correct procedure.

b. V'TECS, Machine Shop, Task No. 33.

c. Bergwall, Study Guide, filmstrip questions.

TASK

GM-22 Scraping flat and curved bearing surfaces

PERFORMANCE OBJECTIVE

Scrape flat and curved bearing surfaces for making smooth running machine parts and surface plates.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Materials used for surface plates
b. Purpose of scraping
c. Using a straight edge for scraping
    1. Procedure
    2. Purpose
d. Scrapers
    1. Materials made of
    2. Types of
e. Marking materials used in scraping
f. Figuring the list price of cast iron surface plate

Provide Demonstration On:

a. Scraping a surface plate
b. Calculating list price of cast iron surface plate

Provide Practical Application On:

Scrape bearing surfaces to smoothness.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

A/Vs:

Bergwall, filmstrip #505-1, "Bench Metal Work"

Student Manuals:

Ohio, Machine Trades I, Bench Work Assignment Sheet #13

Tools and Equipment:

a. Scraper
b. Marking tools

CLASSROOM HOURS

2

EVALUATION (GM-22)

a. Given a bearing surface, the student will be able to choose the appropriate tools and scrape the surface to smoothness.

b. Bergwall, Study Guide, filmstrip question.

TASK

GM-23 Using hammers and screwdrivers for hand bench use

PERFORMANCE OBJECTIVE

Use hammers and screwdrivers for hand bench use.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Main parts of a machinist's hammer
b. Hammer safety
c. Soft hammer heads
d. Types of hammers
e. Hammer handles
f. Screwdriver safety
g. Grinding a screwdriver
h. Choosing a screwdriver

Provide Demonstration On:

a. Tightening a hammer head
b. Grinding a screwdriver

Provide Practical Application On:

a. Use a hammer to ding a metal surface.
b. Grind a screwdriver head.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

A/Vs:

Bergwall, filmstrip #505-6, "Bench Metal Work"

Student Manuals:

Ohio, Machine Trades I, Bench Work Assignment Sheet #14

Tools and Equipment:

a. Hammers
b. Screwdrivers
c. Grinding wheel

CLASSROOM HOURS 4

EVALUATION (GM-23)

a. Given a hammer and a screwdriver, the student will be able to use the tools for an assigned task observing correct procedures and safety practices.

b. Bergwall, Study Guide, filmstrip questions.

TASK

GM-24 Identifying and using wrenches

PERFORMANCE OBJECTIVE

Identify and use wrenches.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Wrenches
   1. Types
   2. Safety
   3. Leverage
   4. Safety
b. Using an adjustable wrench
c. Holding and checking nuts
d. Checking nut tightness

Provide Demonstration On:

Using wrenches
a. Open end
b. Box end
c. Adjustable
d. Spanner types

Provide Practical Application On:

Identify and use several different types of wrenches properly.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

A/Vs:

Bergwall, filmstrip #505-6, "Bench Metal Work"

Student Manuals:

Ohio, Machine Trades I, Bench Work Assignment Sheet #15

Tools and Equipment:

a. Wrenches
b. American Machinist's Handbook
c. Machinery's Handbook

CLASSROOM HOURS

4

EVALUATION (GM-24)

a. Given a selection of wrenches and an assigned nut to tighten, the student will be able to select the appropriate wrench and follow correct safety procedures to tighten the nut.

b. Bergwall, Study Guide, filmstrip questions.

TASK

GM-25 Using bench vises and clamps

PERFORMANCE OBJECTIVE

Use the bench vise or clamps to hold materials for bench work.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types of vises
b. Kinds of metals vises are made of
c. False protective jaws
d. Parts of a bench vise
e. How a vise is fastened to a bench

Provide Demonstration On:

Fastening materials in a bench vise

Provide Practical Application On:

Use a bench vise to hold material for bench work operation.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

Student Manuals:

Ohio, Machine Trades I, Bench Work Assignment Sheet #16

Tools and Equipment:

a. Machinery's Handbook
b. Bench vise or clamps

CLASSROOM HOURS	4

EVALUATION (GM-25)

Given a material to bend, snip, polish, file or perform other bench work on, the student will secure the material in a bench vise following correct procedures and all related precautions.

TASK

GM-26 Identifying and using chipping tools

PERFORMANCE OBJECTIVE

Identify and be able to use tools for chipping.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Angles between facets of a chisel
b. Types of chisels
c. Chipping guard
d. Chipping a keyway
e. Safety
f. Amount of material to leave for finishing

Provide Demonstration On:

a. Choosing a chisel for a job
b. Proper use of a chisel

Provide Practical Application On:

Use a chisel for an assigned chipping operation.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

Student Manuals:

a. Ohio, Machine Trades I, Bench Work Assignment Sheet #17
b. Machine Shop Training Course, Vol. 2

Tools and Equipment:

a. Chipping tools
b. Vise
c. Machinery's Handbook

CLASSROOM HOURS

4

EVALUATION (GM-26)

Given an assigned chipping to be done, the student will be able to choose the correct type of chisel and use the chisel to chip the material to appropriate tolerances following all procedures and safety precautions.

TASK

GM-27 Using hand taps, dies and hand reamers

PERFORMANCE OBJECTIVE

Use hand taps, dies and hand reamers.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Threads
  1. National Fine (N.F.)
  2. National Coarse (N.C.)
b. Tapering pipe taps
c. Bottom taps
d. Tap sets
e. Plug taps
f. Blind hole
g. Pulley tap
h. Tap drill
i. Tap drill sizing formula
j. Tap safety

(Continued on back)

Provide Demonstration On:

a. Checking a tap for square alignment with a hole
b. Using a tap set
c. Cutting threads using die set

Provide Practical Application On:

a. Tap a hole with a handtap.
b. Cut threads with a hand die.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

A/Vs:

a. Bergwall, filmstrip #505-5, "Bench Metal Work"
b. Prentice-Hall, filmstrip #VD930-4, "Machine Shop: Bench Operations"

Student Manuals:

Ohio, Machine Trades I, Bench Work Assignment Sheet #18

Tools and Equipment:

a. Handtaps
b. Dies
c. Reamers
d. American Machinist's Handbook
e. Machinery's Handbook
f. Squares

CLASSROOM HOURS 4

EVALUATION (GM-27)

a. Given a tap set and a hand die set, the student will be able to tap internal threads and cut threads on a stud following appropriate procedures and all safety precautions.

b. V'TECS, Machine Shop, Task Nos. 57, 59 and 64.

c. Bergwall, Study Guide, filmstrip questions.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

k. Dies
    1. Threading dies
    2. Solid threading dies
    3. Adjustable die
    4. Die stock
l. Chamfering rod prior to threading
m. Lubrication
n. Major diameter and minor diameter
o. Safety

TASK

GM-28 Identifying power tool safety practices

PERFORMANCE OBJECTIVE

Identify safety procedures for using power tools in bench work.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types of power tools
    1. Electrical
    2. Pneumatic
b. Electrical hazards
c. Mechanical hazards
d. Safety rules for
    1. Power drills
    2. Impact wrenches
    3. Power drivers
    4. Polishes

Provide Practical Application On:

List safety rules for operation of
a. Power drills
b. Impact wrenches
c. Power drivers
d. Polishers

INSTRUCTIONAL MATERIALS

A/Vs:

Bergwall, filmstrip #514, "Working With Power Tools and Machines"

Student Manuals:

Ohio, Machine Trades I, Bench Work Assignment Sheet #19

Tools and Equipment:

a. Safety posters
b. U.S. Navy, Tools and Their Uses

CLASSROOM HOURS

2

EVALUATION (GM-28)

a. Given several power tools used in the machine shop, the student will identify electrical and mechanical hazards associated with the use of the tool.

b. Bergwall, Study Guide, filmstrip questions.

TASK

GM-29 Assembling and fitting

PERFORMANCE OBJECTIVE

Make a drive, sliding, running and shrink fit for outside and inside measurements for gears, pulleys, bushings, shafts, spindles and threads.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Standard shafting
b. Tolerance
c. Precautions in making a press fit
d. Types/kinds of running fits
e. Shrink fit
f. Types of fits
    1. Loose fit
    2. Free fit
    3. Medium fit
    4. Snug fit
    5. Wringing fit
    6. Tight fit
    7. Medium fit
    8. Heavy force and shrink fit

Provide Demonstration On:

Making the following types of fits
a. Drive
b. Sliding
c. Running
d. Shrink

Provide Practical Application On:

Make the following types of fits
a. Drive
b. Sliding
c. Running
d. Shrink

INSTRUCTIONAL MATERIALS

Textbooks:

Burghardt, Part I

A/Vs:

Bergwall, filmstrip #505-6, "Bench Metal Work"

Student Manuals:

a. Ohio, Machine Trades I, Bench Work Assignment Sheet #20
b. Machine Shop Training Course, Vol. I

Tools and Equipment:

Machinery's Handbook

CLASSROOM HOURS

4

EVALUATION (GM-29)

a. Given necessary tools and equipment, the student will make drive, sliding, running and shrink fits according to correct procedures.

b. Bergwall, Study Guide, filmstrip questions.

TASK

GM-30 Identifying fasteners

PERFORMANCE OBJECTIVE

Identify types of screws, bolts and nuts.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Cut screw thread
b. Rolled screw thread
c. Screw thread inspection methods
d. Types of cuts on machine screws
e. Included angle of the standard V-thread
f. Purpose of an eye bolt
g. Allen set screws
h. Process of rolling a thread
i. Screw thread forms
j. Types of pins
k. Types of T-slot nuts
l. Types of washers
m. Types of screw heads
n. Types of screws
o. Studs

Provide Practical Application On:

Identify various fasteners from a random selection.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe

A/Vs:

Prentice-Hall, filmstrip #XF1128-3, "Working with Nuts and Bolts"

Student Manuals:

a. Ohio, Machine Trades I, Bench Work Assignment Sheet #21
b. Machine Shop Training Course, Vol. I

Tools and Equipment:

a. American Machinist's Handbook
b. Commercial supply catalogs
c. Machinery's Handbook
d. Selection of fasteners

CLASSROOM HOURS

4

EVALUATION (GM-30)

Given a random selection of fasteners, the student will be able to correctly identify each fastener and describe its application.

TASK

GM-31 Using thread, center, fillet and radius gages

PERFORMANCE OBJECTIVE

Use the thread, center, fillet and radius gages for accurate gaging in bench work operations.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Tolerance or allowance on threads
b. Methods of measuring screw threads
c. Wire methods of gaging threads
d. Screw thread micrometer
e. Types of threads
f. Fillet gage
g. Radius gage

Provide Demonstration On:

a. Using a screw thread micrometer
b. Using a fillet gage
c. Using a radius gage
d. Choosing a gage

Provide Practical Application On:

Choose a gage for an assigned measurement and use either a thread, center, fillet or radius gage as appropriate.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

A/Vs:

Bergwall, filmstrip #503, "Measuring Tools Explained"

Student Manuals:

a. Ohio, Machine Trades I, Bench Work Assignment Sheet #22
b. Machine Shop Training Course, Vol. I

Tools and Equipment:

a. Thread gage
b. Fillet gage
c. Center gage
d. Radius gage

(Continued on back)

CLASSROOM HOURS

4

EVALUATION (GM-31)

a. Given an assigned measurement and appropriate gages, the student will choose the appropriate gage and make a measurement using either a thread, center, fillet or radius gage. The completed task must meet the instructor's specifications.

b. Bergwall, Study Guide, filmstrip questions.

INSTRUCTIONAL MATERIALS

Tools and Equipment:

e. American Machinist's Handbook
f. Machinery's Handbook

TASK

GM-32 Identifying lubricants and greases

PERFORMANCE OBJECTIVE

Identify lubricants and greases used for machine maintenance.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Grease
b. Greasing devices
c. Lubricants used for vertically mounted motor
d. Lubricants used for horizontal motors
e. Viscosity
f. Bearing overheated factors
g. Lubrication systems
h. Drip and wick feeds

Provide Demonstration On:

Choosing a lubricant for a given application

Provide Practical Application On:

Choose the appropriate lubricant for a given application.

INSTRUCTIONAL MATERIALS

A/Vs:

Bergwall, filmstrip #501, "The Lathe Explained"

Student Manuals:

Ohio, Machine Trades I, Bench Work Assignment Sheet #23

Tools and Equipment:

a. Commercial supply catalog
b. Machinery's Handbook

CLASSROOM HOURS 4

EVALUATION (GM-32)

a. Given specifications for a machine which requires lubrication and a lubricant supplier's catalog, the student will be able to choose the appropriate lubricant and method of lubrication specified by the instructor.

b. Bergwall, Study Guide, filmstrip questions.

TASK

GM-33 Performing machine maintenance

PERFORMANCE OBJECTIVE

Perform general shop repairs to maintain shop equipment.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Responsibility for repairs in shop
b. Troubleshooting procedures
c. Using manufacturer's service manual
d. Safety in machine maintenance

Provide Demonstration On:

Troubleshooting shop machinery

Provide Practical Application On:

Troubleshoot a machine which is down and diagnose the problem.

INSTRUCTIONAL MATERIALS

Textbooks:

Specific manufacturer's service manuals

A/Vs:

Prentice-Hall, filmstrip #XF928, "Machine Shop: Engine Lathe"

Student Manuals:

Ohio, Machine Trades I, Bench Work Assignment Sheet #24

CLASSROOM HOURS

4

EVALUATION (GM-33)

Given a machine which requires service and a manufacturer's service manual, the student will be able to troubleshoot and diagnose the problem and identify the correct repair procedure.

TASK

GM-34 Identifying bench work safety

PERFORMANCE OBJECTIVE

Identify hazards and safety precautions in working with hand tools and portable power tools in the machine shop.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Eye protection
b. Foot protection
c. Ear protection
d. Dust and hazardous fumes
e. Clothing, hair and jewelry
f. Hand protection
g. Lifting

Provide Demonstration On:

Identifying safety hazards in the shop

Provide Practical Application On:

Identify safety hazards in the shop and recommend solutions.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Porter
c. Kibbe

A/Vs:

Bergwall, filmstrip #514, "Metal Shop Saftey"

Student Manuals:

Ohio, Machine Trades I, Bench Work Assignment Sheet #25

Tools and Equipment:

Safety goggles

CLASSROOM HOURS

2

EVALUATION (GM-34)

a. Given safety hazards in the shop, the student will be able to identify the hazards and recommend safe solutions that are in accordance with the instructor's specifications.

b. Bergwall, Study Guide, filmstrip questions.

TASK

SM-01 Identifying materials used in sheet metalwork

PERFORMANCE OBJECTIVE

Identify materials used in sheet metalwork.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Properties of sheet metals
   1. Strength
   2. Ductility
   3. Malleability
   4. Weldability
   5. Hardness
   6. Toughness
   7. Brittleness
   8. Cold-working
b. Types of sheet metal
   1. Metals
   2. Alloys
   3. Coated metals

(Continued on back)

Provide Demonstration On:

a. Identifying types of sheet metal
b. Making property tests on various sheet metals
c. Determining gage, weight and size of metals

Provide Practical Application On:

a. Have student compare various sheet metals by making simple property tests and note how metals react to:
   1. Hammering
   2. Bending
   3. Weight

(Continued on back)

INSTRUCTIONAL MATERIALS

Textbooks:

a. Johnson
b. Feirer

A/Vs:

Bergwall, filmstrip #507-1, "Sheet Metal Work"

Tools and Equipment:

a. Metal samples
   1. Galvanized iron
   2. Tin plate
   3. Galvannealed iron
   4. Zinc
   5. Black iron sheets
   6. Sheet copper
   7. Aluminum
   8. Stainless steel

(Continued on back)

CLASSROOM HOURS 10

EVALUATION (SM-01)

a. Given various samples of sheet metals, the student will accurately identify each as to type of metal, alloy or coated metal.

b. Given an instructor developed test, the student will accurately relate the special properties required of metals used in the sheet metal industry.

c. Bergwall, Study Guide, filmstrip questions.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

c. Factors that determine the selection of various metals
    1. Specifications
    2. Availability
    3. Cost
    4. Economical sizes
d. Standard gages, weights and sizes of sheet metal

Provide Practical Application On:

b. Have student visually identify metal samples on display board.

INSTRUCTIONAL MATERIALS

Tools and Equipment:

b. Hammer
c. Thickness gage calipers
d. Standard gage and weight tables
e. Rules

TASK

SM-02 Developing sheet metal patterns (stretchouts)

PERFORMANCE OBJECTIVE

Develop a straight-line, a parallel-line, a radial-line and a triangulation sheet metal pattern (stretchout).

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types of patterns
   1. Straight-line or angular
   2. Parallel-line or cylindrical development
   3. Triangulation or transition
b. Hems
   1. Single
   2. Double
c. Seams
   1. Lap
   2. Grooved
d. Edges (wired)
e. Master patterns or templates
f. Notching and clipping

Provide Demonstration On:

a. Developing a straight-line layout
b. Developing a parallel-line layout
c. Developing a radial-line layout
d. Developing a triangulation layout
e. Making allowances for edges, seams and hems
f. Notching and dipping sheet metal

Provide Practical Application On:

a. Have student develop stretchouts using straight, parallel, radial and triangulation layout.

(Continued on back)

INSTRUCTIONAL MATERIALS

Textbooks:

a. Johnson
b. Feirer

A/Vs:

Bergwall, filmstrip #507-2, 507-3, "Sheet Metal Work"

Student Manuals:

Georgia, Metal Fabrication Cluster, PLACE Package Title No. BSMO-1, BSMO-2, BSMO-8, MSB-1, MSB-2

Tools and Equipment:

a. Paper
b. Prick punch
c. Scratch awl
d. Pencil
e. Protractor
f. Straight edge
g. Sheet metal

CLASSROOM HOURS

15

EVALUATION (SM-02)

a. Using appropriate tools and straight, parallel, radial and triangulation developments, the student will accurately layout a pattern (stretchout) of each and accurately transfer each to sheet metal.

b. Georgia, Metal Fabrication Cluster, Teachers Edition.

c. Bergwall, Study Guide, filmstrip questions.

INSTRUCTIONAL ACTIVITIES

Provide Practical Application
On:

b. Have student transfer pattern to sheet metal.

TASK

SM-03 Cutting sheet metal

PERFORMANCE OBJECTIVE

Cut sheet metal using hand snips.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Hand snips
    1. Straight snips
    2. Double cutting snips
    3. Hawk-billed snips
    4. Aviation snips
    5. Circular cutting snips
    6. Heavy duty snips
b. Cutting straight and curved lines
c. Using the hollow punch
d. Portable power shears
e. Rotary and lever slitting shears
f. Squaring shears
    1. Front gage
    2. Back gage
    3. Front and bevel-gage with pattern
g. Cold chisel

Provide Demonstration On:

a. Cutting sheet metal with hand snips
b. Using the hollow punch
c. Cutting sheet metal using portable power, rotary and lever slitting shears
d. Cutting sheet metal with squaring shears

Provide Practical Application On:

a. Have student use hand snips to cut a pattern layout.
b. Have student cut sheet metal with squaring shears.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Johnson
b. Feirer

A/Vs:

a. Bergwall, filmstrip #507-4, "Sheet Metalwork"
b. Prentice-Hall filmstrip #XF934-1, "Sheet Metal Work"

Student Manuals:

Georgia, Metal Fabrication Cluster, PLACE Package Title No. BSMO-3, BSMO-4, BSMO-5, BSMO-7, BSMO-9

Tools and Equipment:

a. Squaring shears
b. Hand snips
c. Metal
d. Pattern
e. Prick punch
f. Scratch awl

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CLASSROOM HOURS

20

EVALUATION (SM-03)

a. Provided a pattern and metal, the student will accurately cut sheet metal to the pattern using hand snips.

b. Provided a pattern and metal, the student will accurately transfer the pattern and use squaring shears to cut the metal.

c. Georgia, Metal Fabrication Cluster, Teachers Edition.

d. Bergwall, Study Guide, filmstrip questions.

INSTRUCTIONAL MATERIALS

Tools and Equipment:

g. Hollow punch
h. Ballpeen hammer
i. Cold chisel
j. Jacksaw
k. Combination square

TASK

SM-04 Bending sheet metal by hand

PERFORMANCE OBJECTIVE

Bend sheet metal by hand.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Bending equipment
    1. Bench plate or stakeholder
    2. Breakhorn stake
    3. Bottom stake
    4. Coppersmith stake
    5. Common square stake
    6. Beveled-edge stake
    7. Double-seaming stake
    8. Round-heat stake
    9. Hatchet stake
    10. Creasing stake
    11. Needle case stake
    12. Candlemold stake
    13. Blowhorn stake
    14. Conductor stake

(Continued on back)

Provide Demonstration On:

a. Using stakes, seamers, hammers and mallets
b. Making angular bends
c. Bending cylindrical shapes
d. Forming cone-shaped articles

Provide Practical Application On:

a. Have student make a sharp-angle bend over hatchet.
b. Have student form a curved piece over a stake or pipe.
c. Have student form a cone-shaped object such as part of a funnel.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Johnson
b. Feirer

A/Vs:

Bergwall, filmstrip #507-6, "Sheet Metal Work"

Student Manuals:

Georgia, Metal Fabrication Cluster, PLACE Package Title No. BSMO-10, BSMO-11, BSMO-12

Tools and Equipment:

a. Stakes
b. C-clamps
c. Vise
d. Hardwood blocks
e. Steel bars
f. Wooden or rawhide mallet
g. Riveting hammer

(Continued on back)

CLASSROOM HOURS

20

EVALUATION (SM-04)

a. Using previously cut metal and appropriate bending tools, the student will, by hand, make a box with 1/32" accuracy and form a cylinder and a cone to job specifications.

b. Georgia, Metal Fabrication Cluster, Teachers Edition.

c. Bergwall, Study Guide, filmstrip questions.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

  15. Hollow mandrel stake
  16. Double-seaming stake
  17. Handy seamer
  18. Riveting hammer
  19. Setting-down hammer
  20. Wooden or rawhide mallet
b. Angular bends
c. Bending cylindrical shapes
d. Forming cone-shaped articles

INSTRUCTIONAL MATERIALS

Tools and Equipment:

h. Setting-down hammer
i. Seamers
j. Metal

TASK

SM-05 Bending metal on a bar folder or brake

PERFORMANCE OBJECTIVE

Bend metal on a bar folder or brake.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Operation of the bar folder
b. Making a fold or hem
c. Making a rounded fold for a wired edge
d. Brakes
    1. Cornice brake
    2. Box and pan brake

Provide Demonstration On:

a. Operating the bar folder
b. Forming folds and hems on the bar folder
c. Operating brakes

Provide Practical Application On:

a. Have student use the bar folder to form a sharp fold, a rounded fold, right-angle folds, a hem and a double hem.
b. Have student use a box and pan brake to form a box.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Johnson
b. Feirer

A/Vs:

Bergwall, filmstrip #507-5, "Sheet Metal Work"

Student Manuals:

Georgia, Metal Fabrication Cluster, PLACE Package Title No. BSMO-13, BSMO-14, BSMO-15

Tools and Equipment:

a. Bar folder
b. Brake
c. Setting hammer
d. Metal
e. Mallet

CLASSROOM HOURS 10

EVALUATION (SM-05)

a. Using sheets of metal and a bar folder, the student will accurately form a sharp fold, a rounded fold, right-angle folds, a hem and a double hem.

b. Using a box and pan brake, the student will accurately make a layout on the metal and form a box.

c. Georgia, Metal Fabrication Cluster, Teachers Edition.

d. Bergwall, Study Guide, filmstrip questions.

TASK

SM-06 Roll-forming sheet metal

PERFORMANCE OBJECTIVE

Roll-form sheet metal.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Operation of forming rolls or slip-roll forming machines
b. Forming a cylinder
c. Rolling a cylinder with a fold on both edges
d. Rolling a cylinder with a wired edge
e. Forming cone shapes

Provide Demonstration On:

a. Operating the roll-forming machine
b. Forming a cylinder or a cylinder with a fold on both edges
c. Rolling a cylinder with a wired edge
d. Forming cone shapes

Provide Practical Application On:

a. Have student form a cylinder and a cylinder with a fold on both edges.
b. Have student roll a cylinder with a wired edge.
c. Have student roll-form a cone shape.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Johnson
b. Feirer

A/Vs:

Bergwall, filmstrip #507-6, "Sheet Metal Work"

Student Manuals:

Georgia, Metal Fabrication Cluster, PLACE Package Title No. SMP-1

Tools and Equipment:

a. Metal
b. Roll-forming machine

CLASSROOM HOURS

25

EVALUATION (SM-06)

a. Using a roll-forming (or slip rolling) machine and sheets of metal, the student will accurately form a cylinder, a cylinder with a fold on both edges, a cylinder with wired edge and a cone.

b. Georgia, Metal Fabrication Cluster, Teachers Edition.

c. Bergwall, Study Guide, filmstrip questions.

TASK

SM-07 Making seams

PERFORMANCE OBJECTIVE

Form sheet metal seams.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

- a. Seams
  - 1. Single
  - 2. Butt
  - 3. Lap
    - a. Plain lap
    - b. Countersink or offset lap
    - c. Inside or outside corner lap
  - 4. Grooved and folded
  - 5. Standing
  - 6. Double
  - 7. Cap-strip
  - 8. Pittsburg lock
- b. Hand groovers

Provide Demonstration On:

- a. Double-seaming a button on a cylinder
- b. Double-seaming a square or rectangular article
- c. Making a folded grooved seam

Provide Practical Application On:

- a. Have student form single, butt, lap, standing and double seams.
- b. Have student form a folded and a grooved seam.

INSTRUCTIONAL MATERIALS

Textbooks:

- a. Johnson
- b. Feirer

A/Vs:

- a. Prentice-Hall, filmstrip #XF934-4, "Sheet Metal Work"
- b. Bergwall, filmstrip #507-7, "Sheet Metal Work"

Student Manuals:

Georgia, Metal Fabrication Cluster, PLACE Package Title No. BSMO-6, BSMO-12, SMP-2 through SMP-9

Tools and Equipment:

- a. Bar folder or brake
- b. Burring machine
- c. Hand groover
- d. Setting hammer
- e. Mallet
- f. Stakes
- g. Metal

CLASSROOM HOURS

30

EVALUATION (SM-07)

a. Given a burring or flanging machine, setting hammer and a cylinder, the student will accurately form single seams to fasten a bottom to the cylinder.

b. Given a bar folder, mallet, setting hammer and metal, the student will accurately form a double seam on a square container.

c. Given a bar folder, metal, a hand groover and mallet, the student will accurately form a folded or grooved seam.

d. Georgia, Metal Fabrication Cluster, Teachers Edition.

e. Bergwall, Study Guide, filmstrip questions.

TASK

SM-08 Using the rotary machine

PERFORMANCE OBJECTIVE

Use the rotary machine to wire an edge, turn a burr, bend and crimp sheet metal.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. The combination rotary machine
b. Making a wired edge
c. Closing the wired edge by hand
d. Closing the wired edge by machine
e. Turning a burr or flange
f. Beading
    1. The single bead
    2. The ogee bead
    3. The triple bead
g. Crimping
h. Slitting and trimming

Provide Demonstration On:

a. Using the rotary machine
b. Wiring an edge
c. Turning a burr
d. Beading
e. Crimping

Provide Practical Application On:

a. Have student wire an edge.
b. Have student bead, crimp, slit and trim metal.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Johnson
b. Feirer

Tools and Equipment:

a. Combination rotary machine
b. Mild steel wire
c. Stakes
d. Pliers
e. Mallet
f. Setting hammer
g. Metal

CLASSROOM HOURS

20

EVALUATION (SM-08)

a. Using the combination rotary machine, hand tools and wire, the student will select the appropriate tools and accurately wire the edge of a cylinder.

b. Given a cylindrical container, the student will select the appropriate rolls to be placed on the combination rotary machine and accurately form a single bead, an ogee bead and a triple bead.

c. Given a cylindrical object, such as a heating pipe, the student will select the appropriate rolls to be placed on the combination rotary machine and accurately crimp the edge of one end of the pipe.

TASK

SM-09 Fastening sheet metal

PERFORMANCE OBJECTIVE

Fasten sheet metal with rivets or sheet metal screws.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Drilling riveting tools and rivets
  1. Riveting hammer
  2. Solid punch
  3. Rivet set
  4. Tinner's rivets
    a. Black-iron
    b. Galvanized
    c. Copper
  5. Blind or pop rivets
  6. Hand lever
b. Riveting sheet metal
  1. Determining rivet length
  2. Determining rivet diameter
  3. Spacing rivets
  4. Removing a rivet

(Continued on back)

Provide Demonstration On:

a. Using riveting tools and rivets
b. Riveting sheet metal
c. Fastening sheet metal with tapping screws

Provide Practical Application On:

a. Have student rivet sheet metal.
b. Have student fasten sheet metal with tapping screws.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Johnson
b. Feirer

A/Vs:

a. Bergwall, filmstrip #507-7, "Sheet Metal Work"
b. Prentice-Hall, filmstrip #XF934-2 and #XF934-5, "Sheet Metal Work"

Tools and Equipment:

a. Rivet set
b. Solid punch
c. Riveting hammer
d. Hand lever
e. End-grain wood or lead block
f. Metal
g. Prick punch
h. Drills
i. Screws
j. Screwdriver

CLASSROOM HOURS

20

EVALUATION (SM-09)

a. Given riveting tools, rivets and a seam to be fastened, the student will accurately select the appropriate tools and set the necessary rivets.

b. Given two pieces of metal to secure together, the student will accurately select the appropriate tools and fasten the metal with threaded fasteners.

c. Bergwall, Study Guide, filmstrip questions.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

c. Fastening with tapping screws
    1. Thread cutting screws
    2. Thread forming screws
d. Installing sheet metal screws

TASK

SM-10 Soft soldering sheet metal

PERFORMANCE OBJECTIVE

Soft solder sheet metal.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Soldering
b. Soldering devices
   1. Soldering coppers
   2. Soldering furnace or blowtorch
   3. Electric soldering iron
   4. Soldering gun
   5. Bunsen burner
   6. Bottled-gas soldering torch
c. Solders (soft)
   1. Bar
   2. Solid wire
   3. Acid or resin-core wire
   4. Soldering paste

(Continued on back)

Provide Demonstration On:

a. Using soldering devices
b. Tinning a soldering copper
c. Resistance soldering
d. Sweat soldering

Provide Practical Application On:

a. Have student solder a right-angle joint.
b. Have student solder an appendage.
c. Have student tin a soldering copper.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Johnson
b. Feirer

A/Vs:

a. Prentice-Hall, filmstrip #XF934-3, "Sheet Metal Work"
b. Bergwall, filmstrip #507-7, "Sheet Metal Work"

Student Manuals:

Georgia, Metal Fabrication Cluster, PLACE Package Title No. BSMO-16, MSB-5

Tools and Equipment:

a. Soldering coppers
b. Solders
c. Fluxes
d. Bunsen burner
e. Electric soldering iron
f. Sal ammoniac
g. Cleaning fluid

(Continued on back)

CLASSROOM HOURS

10

EVALUATION (SM-10)

a. Given two pieces of metal, cleaning materials, flux, a soldering copper and solder, the student will accurately solder a seam.

b. Given three pieces of metal, flux, solder, soldering copper and bunsen burner, the student will accurately sweat solder the metal.

c. Georgia, Metal Fabrication Cluster, Teachers Edition.

d. Bergwall, Study Guide, filmstrip questions.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

d. Fluxes
    1. Corrosive
    2. Non-corrosive
e. Tinning a soldering copper
f. Cleaning sheet metal before soldering
g. Soldering a seam or joint
h. Sweat soldering
i. Resistance soldering
    1. Power unit
    2. Hand piece
    3. Electrodes

INSTRUCTIONAL MATERIALS

Tools and Equipment:

h. Wire brush
i. File
j. Abrasive cloth
k. Steel wool

TASK

WL-01 Practicing safety

PERFORMANCE OBJECTIVE

Demonstrate a knowledge of shop regulations, safety and the use of instructional materials.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Shop layout
b. Learning Resource Center
c. Regulations
d. Audiovisual materials
e. Shop safety
f. Welding terminology

INSTRUCTIONAL MATERIALS

Textbooks:

a. Georgia, Welding, Instructor Guide
b. Giachino and Weeks
c. Griffin, Welding Processes

A/Vs:

Georgia, slide/tape (A-04), "General Shop Safety"

Student Manuals:

Georgia, Welding, Phase A, Unit 1

CLASSROOM HOURS 5

EVALUATION (WL-01)

a. Given a list of standard shop materials, equipment and practices, the student will correctly identify safe and unsafe practices and precautionary measures to be taken to prevent hazardous situations.

b. Georgia, Welding, Instructor Guide, Vol. II, Written Test A-1.

TASK

WL-02 Identifying and using welding symbols

PERFORMANCE OBJECTIVE

Correctly identify standard welding symbols and interpret shop sketches.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Uses of welding symbols
b. The basic welding symbol
  1. Reference line
  2. Arrow
  3. Tail
  4. Arrow side
  5. Other side
c. Weld symbols for type of joint of weld
  1. Groove (Square, V, Bevel, U, J, Flare-V and Flare-Bevel)
  2. Fillet
  3. Plug or slot
  4. Seam
  5. Back or backing
  6. Surfacing
  7. Flange

(Continued on back)

Provide Demonstration On:

Standard and supplementary symbols and their meanings

Provide Practical Application On:

a. Interpret symbols from shop sketches and drawings.
b. Draw symbols for various types of welds.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Griffin, Welding Processes
b. Schell and Matlock

Tools and Equipment:

a. American Welding Society, Chart of Standard Welding Symbols
b. Samples of various types of welded joints
c. Shop sketches

CLASSROOM HOURS 8

EVALUATION (WL-02)

The student will correctly identify symbols that appear on the American Welding Society chart of standard welding symbols and will draw symbols to represent sample welds presented by the instructor.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

d. Dimensions
e. Supplementary symbols
    1. Weld-all-around
    2. Field weld
    3. Melt-thru
    4. Contour
    5. Finish
    6. Groove, angle
    7. Abbreviations
    8. Size or strength
    9. Effective throat
    10. Root opening
    11. Length of weld
    12. Pitch
    13. Number of spot or projection welds

TASK

WL-03 Using welding related shop tools

PERFORMANCE OBJECTIVE

Demonstrate the proper and safe use and care of welding related hand and powered tools and equipment.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Proper care and use of common hand tools
    1. Hammers
    2. Hand saws
    3. Chisels and punches
    4. Brushes
    5. Files
    6. Marking tools
    7. Rules, straight edges, squares, dividers, etc.

b. Proper care and use of common powered tools and equipment
    1. Chipping hammer
    2. Drills
    3. Grinders
    4. Power saws

(Continued on back)

Provide Demonstration On:

Use and care of common shop tools and equipment

Provide Practical Application On:

Use and care of shop tools and equipment

INSTRUCTIONAL MATERIALS

Textbooks:

a. Griffin, *Welding Processes*
b. Schell and Matlock

Tools and Equipment:

Common shop tools and equipment used in welding

CLASSROOM HOURS

10

EVALUATION (WL-03)

The student will correctly identify and demonstrate the proper use and care of common tools and equipment used in welding.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

5. Power brushes
6. Shears
7. Punches

TASK

WL-04 Identifying and preparing metals for welding

PERFORMANCE OBJECTIVE

Describe the chemical, physical and mechanical properties of metals important to welders, the methods for preparing metals and spark testing methods for identifying metals.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Metals important to welders
   1. Low carbon steel
   2. Medium carbon steel
   3. High carbon steel
   4. Stainless steel
   5. Manganese
   6. Grey cast iron
   7. Malleable cast iron
   8. Copper
   9. Brass
   10. Bronze
   11. Lead
   12. Aluminum
   13. Magnesium
   14. White metals
   15. White cast iron

(Continued on back)

Provide Demonstration On:

a. Samples of different types of metals
b. Identifying metals by testing

Provide Practical Application On:

Spark test
1. Brass
2. Steel
3. Cast iron

INSTRUCTIONAL MATERIALS

Textbooks:

a. Georgia, Welding, Instructor Guide
b. Giachino and Weeks
c. Griffin, Welding Processes
d. Oregon

A/Vs:

Georgia, slide/tape (A-7), "Metallurgy"

Student Manuals:

Georgia, Welding, Phase A, Unit 7

Tools and Equipment:

a. 1 brass welding rod
b. 1 steel welding rod
c. 1 cast iron welding rod
d. Safety shield
e. Gloves
f. Metal plates

CLASSROOM HOURS

10

EVALUATION (WL-04)

a. Given samples of the fifteen types of metals listed in this unit, the student will correctly identify each sample by name and by its physical, mechanical and chemical properties.

b. Georgia, Welding, Instructor Guide, Vol. II, Written Test. A-7.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

  6. Channel
  7. Ship channel
  8. Standard pipe
  9. Tubing
  10. Square tubing
  11. Rectangular tubing
  12. Functions and characteristics and specifications of structural shapes

h. Meaning of gage
i. U.S. Standard manufactured thickness for steel
j. Preparing metals for welding
  1. Cleaning
  2. Preparing edges
    -Chamfer
    -Bevel
    -Root opening
    -Bevel on both sides
    -Welding joint on both sides
    -When to use edge types
    -How to make edge types
k. Heat treating process
  1. Annealing
  2. Hardening
  3. Case hardening

Provide Information On:

b. Physical properties of metals
    1. Tensile strength
    2. Ductility
    3. Brittleness
    4. Stress and strain
    5. Elasticity
    6. Compression strength
    7. Fatigue strength
    8. Toughness
    9. Hardness
    10. Corrosion resistance
    11. Weldability
    12. Elongation
    13. Malleability
c. Chemical properties
    1. Composition
    2. Melting point
d. Mechanical properties
    1. Effect of heat on metals
    2. Effect of cold on metals
    3. Relationship to physical properties
e. Spark testing
    1. Method
    2. Meaning of
        -Color of spark stream
        -Length of spark stream
        -Number of explosions (spurts or sprigs)
        -Shape of explosions (forked or repeating)
    3. Spark testing chart
f. Other tests
    1. Oxyacetylene cutting torch test
    2. Magnetic test
    3. Ring test
    4. Chipping test
    5. Filing test
    6. Fracture test
    7. Functional test
    8. Chemical tests
g. Identification of structural shapes
    1. Sheet and plate - hot and cold rolled
    2. Bars
        -Hot and cold rolled
        -Square - hot and cold rolled
        -Round
        -Hexagon or octagon
        -Half round on oval
        -Angle bars
        -Zee bars
    3. Standard I-beam
    4. H-beam
    5. Wide flange beam

(Continued On Next Page)

TASK

WL-05 Measuring welding materials

PERFORMANCE OBJECTIVE

Demonstrate ability to measure and mark materials accurately within 1/16 inch.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Measurement equipment
    1. Rulers (steel rule)
    2. Straight edges
    3. Squares
    4. Soap stone markers
    5. Micrometers (vernier micrometer)
    6. Vernier calipers
    7. Dial indicators
    8. Telescope and small hole gauges
    9. Use of equipment
    10. Function of equipment
    11. Degree of accuracy

b. Measurement techniques
    -Obtaining accuracy

c. English and metric measuring units

Provide Demonstration On:

Types of measurement instruments, their operation and uses

Provide Practical Application On:

Mark a metal for cutting and welding.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Georgia, Welding, Instructor Guide
b. Oregon

Student Manuals:

a. Georgia, Metal Fabrication Cluster, PLACE Package Title No. AW-3
b. Georgia, Welding, Phase A, Unit A-7A

Tools and Equipment:

a. 1 piece of light gage sheet metal at least 5" x 7"
b. 1 square
c. 1 piece of soap stone
d. Ruler
e. Straight edges
f. Micrometer
g. Calipers
h. Telescope and small hole gages

CLASSROOM HOURS 5

EVALUATION (WL-05)

a. Given proper equipment, the student will accurately measure a length of metal to the nearest 1/16 inch and mark off six parallel line spaces within 1/16 inch of given dimensions.

b. Georgia, Metal Fabrication Cluster, Teachers Edition.

TASK

WL-06 Using clamps and jigs

PERFORMANCE OBJECTIVE

Demonstrate the proper use of clamps and jigs for holding metals to be welded.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. The importance of clamps and jigs
b. Using C-clamps
c. Jigs for butt joints
d. Jigs for corner joints
e. Jigs for T-joints
f. Using copper inserts
g. Backing bars
h. Heat sinks
i. Positioning pipe

Provide Demonstration On:

Different types of jigs and their uses

Provide Practical Application On:

Properly set up joints for welding using appropriate clamping and jigs.

INSTRUCTIONAL MATERIALS

Textbooks:

Griffin, Basic TIG & MIG

Tools and Equipment:

a. C-clamps
b. Butt joint jig
c. Corner joint jig
d. T-joint jig
e. Pipe joint jig
f. Heat sinks
g. Backing bars
h. Copper inserts
i. Various metals to be clamped

CLASSROOM HOURS 5

EVALUATION (WL-06)

Given one or more of each of the types of clamps and jigs covered in this unit, the student will demonstrate the correct use of clamps and jigs in setting up metals for standard joint welds.

TASK

WL-07 Reading blueprints

PERFORMANCE OBJECTIVE

Read and interpret blueprints and correctly match finished products with blueprint requirements.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Uses of blueprints
b. Basic lines
c. Basic views
d. Notes and specifications
e. Dimensions
f. Structural shapes
g. Auxiliary views
h. Sections
i. Detail and assembly prints
j. Welding abbreviations and symbols
k. Fabrication

Provide Demonstration On:

Completed projects and their corresponding blueprints

Provide Practical Application On:

a. Read and interpret blueprints.
b. Match blueprints with finished products.

INSTRUCTIONAL MATERIALS

Textbooks:

Bennett

Tools and Equipment:

a. Assorted blueprints
b. Completed welding projects and their corresponding blueprints

CLASSROOM HOURS 10

EVALUATION (WL-07)

Given a set of blueprints and their corresponding finished products, the student will accurately interpret blueprints and match blueprint requirements with finished products.

TASK

WL-08 Following safety procedures and regulations for oxyacetylene welding

PERFORMANCE OBJECTIVE

Demonstrate knowledge of safety hazards, accident prevention, safety regulations and safety equipment.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. General safety precautions for welding
b. Safety hazards
    1. Causes for explosions
    2. Fire hazards
    3. Handling hot metals
    4. Toxic fumes
c. Safety equipment
    1. Protective clothing
    2. Fire extinguishers
    3. Safety devices on equipment
d. Shop safety rules
    1. Safety habits and regulations
    2. Cleanliness

(Continued on back)

Provide Demonstration On:

Types and uses of safety equipment

Provide Practical Application On:

Using fire extinguishers

INSTRUCTIONAL MATERIALS

Textbooks:

a. Georgia, Welding, Instructor Guide
b. Giachino and Weeks
c. Griffin, Basic Oxyacetylene
d. Althouse

A/Vs:

a. Georgia, slide/tape (A-5A), "Safety"
b. Georgia, slide/tape (A-5B), "Safety"

Student Manuals:

Georgia, Welding, Phase A, Unit 5

Tools and Equipment:

a. Fire extinguishers
b. Protective clothing
c. Oxyacetylene equipment

CLASSROOM HOURS

4

EVALUATION (WL-08)

a. Given the types of equipment used in oxyacetylene welding, the student will demonstrate safe practices in handling and using the equipment.

b. Georgia, Welding, Instructor Guide, Vol. II, Written Test A-5.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

   3. Fire prevention
   4. Safe placement and handling of equipment

e. What to do in case of an accident

TASK

WL-09 Using oxyacetylene cylinders and gases

PERFORMANCE OBJECTIVE

Demonstrate a knowledge of cylinders and gases used in oxyacetylene welding.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

- a. Gases and their properties
  - 1. Oxygen
  - 2. Acetylene
  - 3. Other gases
- b. Gas cylinders
  - 1. Operating instructions
  - 2. Safety precautions
  - 3. Care and maintenance
    - Cleaning
    - Testing for leaks
    - What to do if equipment needs repair
    - Transporting and handling
- c. Safety rules in using gases

Provide Demonstration On:

Correct handling of cylinders and the use of safety chains

Provide Practical Application On:

Test for leaks.

INSTRUCTIONAL MATERIALS

Textbooks:

- a. Georgia, Welding, Instructor Guide
- b. Giachino and Weeks
- c. Griffin, Basic Oxyacetylene
- d. Althouse
- e. Oregon

A/Vs:

- a. Georgia, slide/tape (A-2), "Cylinders and Gases"

(Continued on back)

Student Manuals:

Georgia, Welding, Phase A, Unit 2

CLASSROOM HOURS 7

EVALUATION (WL-09)

a. Given a set of oxyacetylene cylinders, hoses, regulators and related apparatus, the student will demonstrate correct procedures for handling, storage and leak testing.

b. Georgia, Welding, Instructor Guide, Vol. II, Written Test A-2.

c. V'TECS, Welding, Task Nos. 39, 41.

d. Bergwall, Study Guide, filmstrip questions.

INSTRUCTIONAL MATERIALS

A/Vs:

b. Bergwall, filmstrip #902-1, "Welding Explained: Oxyacetylene Fusion"
c. Prentice-Hall, filmstrip #XF964-1 "Oxyacetylene Welding"; film loop #XF72003-100, "Oxyacetylene Welding"

TASK

WL-10 Inspecting oxygen and acetylene regulators

PERFORMANCE OBJECTIVE

Demonstrate an ability to identify parts of oxygen and acetylene regulators and describe the function of each regulator part.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Oxyacetylene regulators
    1. Individual parts
    2. How it operates
        -Turning on valves
        -Reading gages
    3. Safety precautions and hazards
    4. Purpose of regulator
    5. Capacity of regulator

Provide Demonstration On:

Disassembly, inspection and reassembly of regulators

Provide Practical Application On:

Disassemble, inspect and reassemble regulators.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Georgia, Welding, Instructor Guide
b. Giachino and Weeks
c. Griffin, Basic Oxyacetylene
d. Althouse
e. Oregon

A/Vs:

Georgia, slide/tape (A-3), "Regulators"

Student Manuals:

Georgia, Welding, Phase A, Unit 3

Tools and Equipment:

a. Vice
b. Screwdrivers
c. Adjustable wrench
d. Box end wrench set
e. Demonstration single stage regulator

CLASSROOM HOURS 7

EVALUATION (WL-10)

a. Given the equipment listed for this task, the student will correctly disassemble the regulator, identify the parts and reassemble the regulator according to procedures covered in this unit.

b. Georgia, Welding, Instructor Guide, Vol. II, Written Test A-3.

c. V'TECS, Welding, Task Nos. 39, 41.

TASK

WL-11 Selecting and maintaining oxyacetylene torches and tips

PERFORMANCE OBJECTIVE

Select the proper size tip and torch for a given job and demonstrate the correct procedures for maintaining tips.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Torch parts
    1. Body or torch handle
    2 Needle valves
    3. Mixer
    4. Tip
b. Function of parts
c. Types of torches
    1. Injector torch
    2. Equal pressure torch
    3. Function of each type
d. Tip
    1. Care
    2. Sizes - chart of tip sizes
    3. Drilling and cutting tips

Provide Practical Application On:

Selecting and cleaning torches and tips

INSTRUCTIONAL MATERIALS

Textbooks:

a. Georgia, Welding, Instructor Guide
b. Giachino and Weeks
c. Griffin, Basic Oxyacetylene
d. Althouse
e. Oregon

A/Vs:

a. Georgia, slide/tape (A-4), "Torches and Tips"
b. Bergwall, filmstrip #902-2 "Welding Explained: Oxyacetylene Fusion"

Student Manuals:

Georgia, Welding, Phase A, Unit 4

Tools and Equipment:

a. Welding tips
b. Tip drills
c. Tip cleaners
d. Injector torch
e. Equal pressure torch

CLASSROOM HOURS

CLASSROOM HOURS	4

EVALUATION (WL-11)

a. Given specifications for different types of welding jobs, the student will correctly select the proper size and type tip for each job.

b. The student will demonstrate the proper procedures for maintaining torch tips.

c. Georgia, Welding, Instructor Guide, Vol. II, Written Test A-4.

d. V'TECS, Welding, Task No. 42.

e. Bergwall, Study Guide, filmstrip questions.

TASK

WL-12 Setting up and lighting the oxyacetylene torch

PERFORMANCE OBJECTIVE

Demonstrate a safe and correct procedure in setting up and lighting an oxyacetylene torch, shutting down the torch and caring for equipment.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Sequence of the torch lighting process
b. Lighting the torch and adjusting the flame
c. Sequence of the depressurizing process
d. Flame types
  1. Neutral
  2. Carburizing
  3. Oxidizing
  4. Function of each flame type
  5. Flame zones
    - Cone
    - Envelope
    - Feather
e. Care and maintenance of equipment

Provide Demonstration On:

Correct torch lighting and shut down procedures

Provide Practical Application On:

Set up and light the torch.
1. Set up the torch.
2. Light and adjust the torch.
3. Shut down the apparatus.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Georgia, Welding, Instructor Guide
c. Griffin, Basic Oxyacetylene
d. Althouse
e. Oregon

A/Vs:

a. Georgia, slide/tape (A-6), "Setting Up and Lighting The Torch"

(Continued on back)

Student Manuals:

a. Georgia, Metal Fabrication Cluster, PLACE Package Title No. GW-1
b. Georgia, Welding, Phase A, Unit 6

Tools and Equipment:

Oxyacetylene welding appartus

CLASSROOM HOURS

4

EVALUATION (WL-12)

a. Given proper equipment, the student will accurately set up and light a torch for welding; adjust to a neutral flame, a carburizing flame and an oxidizing flame; shut down torch and secure equipment according to approved procedures.

b. Georgia, Welding, Instructor Guide, Vol. II, Written Test A-6.

c. Georgia, Metal Fabrication Cluster, Teachers Edition.

d. Bergwall, Study Guide, filmstrip questions.

INSTRUCTIONAL MATERIALS

A/Vs:

b. Bergwall, filmstrip #902-3, "Welding Explained: Oxyacetylene Fusion"

c. Prentice-Hall, filmstrip #ZF964-2,3 "Oxyacetylene Welding"; film loop #XF72003-100, "Oxyacetylene Welding"

TASK

WL-13 Carrying a puddle without a filler rod

PERFORMANCE OBJECTIVE

Using oxyacetylene welding apparatus, control a puddle without a filler rod.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Terminology
    1. Beads
    2. Filler rods
    3. Puddle
    4. Carrying a puddle
    5. Torch motion
        - Circular
        - Zig zag
        - Alternating rod
        - Zipper
        - Oscillating
    6. Forehand welding
    7 Backhand welding

b. Characteristics that guide proper puddling of a metal
    1. Penetration
    2. Torch adjustment
    3. Torch handling

(Continued on back)

Provide Demonstration On:

Method of carrying a puddle without a rod

Provide Practical Application On:

Make a plate with four beads without a filler rod.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Georgia, Welding, Instructor Guide
b. Giachino and Weeks
c. Griffin, Basic Oxyacetylene
d. Althouse
e. Oregon

A/Vs:

a. Georgia, slide/tape (A-8), "Carrying a Puddle Without a Rod"

(Continued on back)

Student Manuals:

a. Georgia, Metal Fabrication Cluster, PLACE Package Title No. GW-2
b. Georgia, Welding, Phase A, Unit 8

Tools and Equipment:

a. Oxyacetylene welding appartus
b. Light gage mild steel plate

CLASSROOM HOURS

6

EVALUATION (WL-13)

a. Using proper oxyacetylene equipment, the student will accurately produce one 4" x 6" plate with four beads five inches long without using a filler rod. These beads must be straight, uniform and evenly spaced.

b. Georgia, Metal Fabrication Cluster, Teachers Edition.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

   4. Torch movement
   5. Torch speed
   6. Angle of torch to metal

c. Appearance of puddle surface

INSTRUCTIONAL MATERIALS

A/Vs:

b. Bergwall, filmstrip #902-4, "Welding Explained: Oxyacetylene Fusion"

c. Prentice-Hall, filmstrip #XF964-4, "Oxyacetylene Welding"; film loop #XF72003-133, "Oxyacetylene Welding"

TASK

WL-14 Welding an outside corner joint without a filler rod, using oxyacetylene equipment

PERFORMANCE OBJECTIVE

Use oxyacetylene equipment to weld an outside corner joint in four positions (flat, horizontal, vertical and overhead) without a filler rod.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Terminology
   1. Corner joint
   2. Base metal
   3. Weld
   4. Groove
   5. Fillet welds
b. Procedure for welding corner joint
   1. Torch angle
   2. Motion of torch
   3. Torch speed
   4. Flame type
c. Positioning of metals to each other
d. Standard for a good joint
e. Testing joints
f. When to weld joints without a rod (thin gage metals)

Provide Demonstration On:

a. Examples of good corner joint welds
b. Proper welding technique
c. Errors and their causes

Provide Practical Application On:

Weld an outside corner joint in the flat, horizontal, vertical and overhead position without the use of a filler rod.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Georgia, Welding, Instructor Guide
b. Giachino and Weeks
c. Griffin, Basic Oxyacetylene
d. Althouse
e. Oregon

A/Vs:

a. Georgia, slide/tape (A-9), "Welding an Outside Corner Joint"
b. Bergwall, filmstrip #902-5, "Welding Explained: Oxyacetylene Fusion"

Student Manuals:

a. Georgia, Metal Fabrication Cluster, PLACE Package Title No. GW-4
b. Georgia, Welding, Phase A, Unit 9

Tools and Equipment:

a. Oxyacetylene welding apparatus
b. Light gage mild steel plate

CLASSROOM HOURS

10

EVALUATION (WL-14)

a. Using proper oxyacetylene equipment, the student will accurately weld an outside corner joint in flat, horizontal, vertical and overhead positions. The joints should be uniform in appearance and have complete penetration and fusion.

b. V'TECS, Welding, Task No. 19.

c. Georgia, Metal Fabrication Cluster, Teachers Edition.

d. Bergwall, Study Guide, filmstrip questions.

TASK

WL-15 Making beads with filler rods using oxyacetylene equipment

PERFORMANCE OBJECTIVE

Demonstrate an ability to produce a plate of beads with a filler rod using an oxyacetylene welding apparatus.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Filler rods
    1. Types and sizes
    2. When to use
    3. Selecting the correct filler rod
b. Using the rod correctly
    1. Angle and motion of rod
    2. Distance from torch and metal
c. Errors and their causes
    1. Burn through
    2. Chilling puddle
    3. Failure to absorb enough heat
d. Correct use of the torch

Provide Demonstration On:

a. Examples of good bead welds
b. Examples of poor welds and their causes

Provide Practical Application On:

Make a plate of beads with a filler rod.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Georgia, Welding, Instructor Guide
b. Giachino and Weeks
c. Griffin, Basic Oxyacetylene
d. Althouse
e. Oregon

Student Manuals:

a. Georgia, Metal Fabrication Cluster, PLACE Package Title No. GW-5
b. Georgia, Welding, Phase A, Unit 10

Tools and Equipment:

a. Oxyacetylene welding apparatus
b. 2 pieces of light gage sheet metal approximately 4" x 6", 1/16" or 3/32"
c. Filler rod

CLASSROOM HOURS

10

EVALUATION (WL-15)

a. Using oxyacetylene welding equipment, the student will accurately produce two 4" x 6" plates of beads with a filler rod, with four beads five inches long on each plate. The beads must be straight, evenly spaced and conform to specifications.

b. Georgia, Metal Fabrication Cluster, Teachers Edition.

TASK

WL-16 Welding butt joints using oxyacetylene equipment

PERFORMANCE OBJECTIVE

Use oxyacetylene welding equipment to weld butt joints in the flat, horizontal, vertical and overhead positions.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types and uses of butt joints
b. Edge preparation
c. Selection of filler rod
d. Welding technique
   1. Torch adjustment
   2. Torch angle and motion
   3. Correct use of the filler rod
e. Specifications for a good weld
f. Types of butt joints
   1. Open
   2. Closed

(Continued on back)

Provide Demonstration On:

a. Examples of good and bad butt welds
b. Proper welding techniques

Provide Practical Application On:

Weld a strong butt joint in the four welding positions.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Georgia, Welding, Instructor Guide
b. Giachino and Weeks
c. Griffin, Basic Oxyacetylene
d. Althouse
e. Oregon

A/Vs.

a. Georgia, slide/tape (A-11), "Welding in a Flat Position"

(Continued on back)

Student Manuals:

a. Georgia, Metal Fabrication Cluster, PLACE Package Title No. GW-6

Tools and Equipment:

a. Oxyacetylene apparatus
b. Steel filler rods
c. Mild steel plate of various gages

CLASSROOM HOURS 10

EVALUATION (WL-16)

a. Using oxyacetylene welding apparatus, the student will accurately weld two butt joints on one side only. The plates will be approximately 4" wide and 5" long. The welds will be done in the flat, horizontal, vertical and overhead positions. One joint will be bent in a vice to check penetration and fusion. All joints will be checked for appearance.

b. V'TECS, Welding, Task Nos. 18, 20, 21, 22, 23, 26, 29 and 34.

c. Georgia, Metal Fabrication Cluster, Teachers Edition.

d. Bergwall, Study Guide, filmstrip questions.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

g. Terminology
   1. Crown
   2. Direction of weld or direction of travel
h. Errors/causes
   1. Uneven weld bead/ incorrect speed
   2. Holes in joint/ holding flame in one spot too long
   3. Brittle weld/ improper flame adjustment
   4. Excessive metal sag/too much penetration
   5. Insufficient penetration/too rapid torch speed
   6. Hole in end of joint/not lifting torch when end reached
   7. Weak joint even though have correct penetration
      - Holding torch too flat
      - Filling space with rod and not melting base metal sufficiently
      - Improper space between the edges of the plate

INSTRUCTIONAL MATERIALS

A/Vs:

b. Georgia, slide/tape (A-12), "Vertical and Overhead Welding"
c. Bergwall, filmstrip #902-5, "Welding Explained: Oxyacetylene Fusion"
d. Prentice-Hall, filmstrip #XF964-5, "Oxyacetylene Welding"; film loop #XG72003-100, "Oxyacetylene Welding"

TASK

WL-17 Welding lap joints using oxyacetylene equipment

PERFORMANCE OBJECTIVE

Demonstrate an ability to weld a lap joint in the horizontal, vertical, flat and overhead positions using oxyacetylene welding apparatus and various gages of mild steel plate.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Definition of lap joint
b. Edge preparation
c. Positioning of metals
d. Selection of filler rod
e. Welding technique
    1. Torch adjustment
    2. Torch angle and motion
    3. Correct use of the filler rod
f. Specifications for a good weld
g. Errors and their causes

Provide Demonstration On:

a. Examples of good and bad lap joint welds
b. Proper welding technique

Provide Practical Application On:

Weld lap joints in the four positions using various gages of mild steel plate.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Georgia, Welding, Instructor Guide
b. Giachino and Weeks
c. Griffin, Basic Oxyacetylene
d. Althouse
e. Oregon

A/Vs:

Bergwall, filmstrip #902-5, "Welding Explained: Oxyacetylene Fusion"

Student Manuals:

a. Georgia, Metal Fabrication Cluster, PLACE Package Title No. GW-7
b. Georgia, Welding, Phase A, Unit 12

Tools and Equipment:

a. Oxyacetylene welding apparatus
b. Steel filler rod
c. Mild steel plate, various gages

CLASSROOM HOURS

10

EVALUATION (WL-17)

a. Using an oxyacetylene welding apparatus, the student will weld lap joints in the horizontal, vertical, flat and overhead positions with proper surface appearance and complete root penetration. Joints must be 6" long and tested by bending in a vice to a 90° angle.

b. V'TECS, Welding, Task No. 24.

c. Georgia, Metal Fabrication Cluster, Teachers Edition.

d. Bergwall, Study Guide, filmstrip questions.

TASK

WL-18 Welding T-joints using oxyacetylene equipment

PERFORMANCE OBJECTIVE

Weld T-joints in the horizontal, vertical, flat and overhead positions using a filler rod.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types and uses of T-joints
b. Edge preparation
c. Positioning of metals
d. Selection of filler rod
e. Welding technique
    1. Torch adjustment
    2. Angle, motion and speed of torch
    3. Correct use of the filler rod
f. Specifications for a good weld
g. Errors and their causes

Provide Demonstrations On:

a. Examples of good and bad T-joints and reasons for errors
b. Proper welding technique

Provide Practical Application On:

Weld T-joints in the four positions using various gages of mild steel plate.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Georgia, Welding, Instructor Guide
b. Giachino and Weeks
c. Griffin, Basic Oxyacetylene
d. Althouse
e. Oregon

A/Vs:

Georgia, slide/tape (A-13), "Welding T-Joints"

Student Manuals:

a. Georgia, Metal Fabrication Cluster, Place Package Title No. GW-8
b. Georgia, Welding, Phase A, Unit A-13

Tools and Equipment:

a. Oxyacetylene apparatus
b. Steel welding rods
c. Mild steel plates, various gages

CLASSROOM HOURS

10

EVALUATION (WL-18)

a. Given oxyacetylene welding equipment and appropriate materials, the student will accurately weld T-joints in horizontal, vertical, flat and overhead positions using a filler rod. All welds should meet standards in clean appearance, uniform bead, equal distribution of metal on each surface and complete penetration and fusion. All welds will be bent and checked for penetration.

b. V'TECS, Welding, Task No. 17.

c. Georgia, Metal Fabrication Cluster, Teachers Edition.

TASK

WL-19 Setting up the oxyacetylene apparatus for flame cutting

PERFORMANCE OBJECTIVE

Set up the oxyacetylene apparatus for flame cutting.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. The principle of oxidation
    1. The effect on metals
    2. The effect of heat
    3. Ferrous metals
    4. Properties of different metals
    5. The effect of metal thickness

b. Cutting torches and apparatus
    1. Manual torch types
        - One piece
        - Combination
    2. Needle valves
    3. Cutting tips
    4. Care and maintenance of equipment

Provide Demonstration On:

Examples of different types of cutting torches and apparatus

Provide Practical Application On:

Select and set up torches and equipment for a flame cutting job.

INSTRUCTIONAL MATERIALS

Textbooks:

a

a. Georgia, Welding, Instructor Guide
b. Giachino and Weeks
c. Griffin, Basic Oxyacetylene
d. Althouse
e. Oregon

A/Vs:

(Continued on back)

Student Manuals:

a. Georgia, Metal Fabrication Cluster, PLACE Package Title No. GC-1
b. Georgia, Welding, Phase A, Unit A-14

Tools and Equipment:

One piece and combination oxyacetylene cutting torches and appartus

CLASSROOM HOURS

5

EVALUATION (WL-19)

a. Given specifications for an oxyacetylene cutting job, the student will select the proper equipment and set up the apparatus for the job.

b. Georgia, Welding, Instructor Guide, Vol. II, Written Test A-14.

c. Georgia, Metal Fabrication Cluster, Teachers Edition.

INSTRUCTIONAL MATERIALS

A/Vs:

a. Georgia, slide/tape (A-14) "The Flame Cutting Process"
b. Bergwall, filmstrip #903-1, "Oxyacetylene Cutting Explained"
c, Prentice-Hall, filmstrip #XF964, "Oxyacetylene Welding"

TASK

WL-20 Cutting with an oxyacetylene cutting torch

PERFORMANCE OBJECTIVE

Light an oxyacetylene cutting torch and make standard welding cuts on mild steel plate, round solids and pipe.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Selecting the correct torch and apparatus
b. Preparing metals
c. Technique for cutting straight lines
d. Cutting circles
    1. Freehand cutting
    2. Using an attachment
    3. Torch adjustment
    4. Angle, speed and motion of torch
    5. Punch marking lines
    6. Ring cutting
e. Bevel cutting
    1. Tip size
    2. Using a guide bar
    3. Torch adjustment

(Continued on back)

Provide Demonstration On:

a. Examples of good cuts
b. Proper cutting techniques
c. Errors and their causes

Provide Practical Application On:

a. Set up and light a torch.
b. Straight line cutting.
c. Bevel cutting.
d. Circle cutting.
e. Round stock cutting.
f. Proper cleaning of equipment.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Georgia, Welding, Instructor Guide
b. Giachino and Weeks
c. Griffin, Basic Oxyacetylene
d. Althouse
e. Oregon

A/Vs:

a. Georgia, slide/tape (A-15), "Cutting a Straight Line"

(Continued on back)

Student Manuals:

a. Georgia, Metal Fabrication Cluster, PLACE Package Title No. GC-2, GC-3, GC-5
b. Georgia, Welding, Phase A, Unit A-15

Tools and Equipment:

a. Oxyacetylene cutting apparatus
b. Cutting attachment
c. Various gages of mild steel plate, round solids and pipe

CLASSROOM HOURS

10

EVALUATION (WL-20)

a. Given an oxyacetylene cutting torch, measuring equipment and other proper materials and equipment, the student will
   1. Correctly set up and light a cutting torch;
   2. Cut five straight, smooth strips of metal;
   3. Cut a circle (should be perfectly round and smooth);
   4. Cut a ring (should be round and smooth);
   5. Cut a beveled edge
      - Finished surface of edge should have perpendicular drag lines
      - Top and bottom edge should be well defined;
   6. Cut a section of a solid shaft; and
   7. Cut a section of pipe.

   All cutting should have a smooth clean appearance and be free of slag.

b. V'TECS, Welding, Task No. 43.

c. Georgia, Metal Fabrication Cluster, Teachers Edition.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

   4. Torch adjustment
   5. Angle, motion and speed of torch
   6. Degrees of beveling

f. Cutting round stock with the manual torch
   1. Torch adjustment
   2. Angle, motion and speed of torch
   3. Tip size for cutting
      - Pipe
      - Round solids

4. Starting the cut

INSTRUCTIONAL MATERIALS

A/Vs:

b. Bergwall, filmstrip #903-2, "Oxyacetylene Cutting Explained"

c. Prentice-Hall, filmstrip #XF964-7, "Oxyacetylene Welding"

TASK

WL-21 Piercing and cutting holes using the oxyacetylene cutting torch

PERFORMANCE OBJECTIVE

Demonstrate an ability to lay out and cut smooth, slag free holes using oxyacetylene cutting apparatus.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Procedures for piercing small holes
   1. Correct tip size
   2. Flame type
   3. Tip movement
      - Slow spiral motion
   4. Obtaining desired hole diameter
b. Procedure for cutting larger holes
   1. Marking line to be cut
   2. Cutting small holes inside hole to be cut
   3. Cutting from small hole to cutting line
   4. Continuing around line

(Continued on back)

Provide Demonstration On:

a. Proper piercing and cutting technique
b. Errors and their causes

Provide Practical Application On:

Pierce and cut holes.
1. Set up equipment.
2. Prepare metal and equipment for cutting.
3. Lay out work.
4. Light torch.
5. Pierce and cut proper holes

INSTRUCTIONAL MATERIALS

Textbooks:

a. Georgia, Welding, Instructor Guide
b. Giachino and Weeks
c. Griffin, Basic Oxyacetylene
d. Althouse
e. Oregon

A/Vs:

a. Georgia, slide/tape (A-16), "Cutting and Piercing Holes"

(Continued on back)

Student Manuals:

a. Georgia, Metal Fabrication Cluster, PLACE Package Title No. GC-4
b. Georgia, Welding, Phase A, Unit A-16

Tools and Equipment:

a. Oxyacetylene cutting apparatus
b. Mild steel plate, various gages
c. Assorted tools

CLASSROOM HOURS 10

EVALUATION (WL-21)

a. Given oxyacetylene hole cutting equipment and proper materials, the student will accurately
   1. Set up cutting equipment;
   2. Layout three holes 2" in diameter; and
   3. Make smooth, slag free cuts.

b. Georgia, Metal Fabrication Cluster, Teachers Edition.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

   5. Perpendicular tip angle to metal plate

c. Alternate procedures for cutting large holes

d. Sizing holes accurately
   -Using a tapered punch

INSTRUCTIONAL MATERIALS

A/Vs:

b. Bergwall, filmstrip #903-2, "Oxyacetylene Cutting"

c. Prentice-Hall, filmstrip #XF964, "Oxyacetylene Welding"

TASK

WL-22 Cutting with an automatic oxyacetylene cutting machine

PERFORMANCE OBJECTIVE

Demonstrate an ability to lay out and cut smooth, slag free cuts using automatic cutting machine.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types of machines
    1. For straight line cutting
    2. For shape cutting
b. Attachments to machines
c. Locating machines
d. Starting machine
e. Operating machine
f. Shutting down machine
g. Cutting procedure with machine
h. Travel speeds - chart
i. Cutting torch operating data - chart

(Continued on back)

Provide Demonstration On:

Operating the cutting machine, and cutting a straight line, circle and a beveled edge

Provide Practical Application On:

a. Set up cutting machine.
b. Make a straight line cut.
c. Make a beveled edge cut.
d. Cut a circle.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Georgia, Welding, Instructor Guide
b. Althouse
c. Cutting machine manual
d. Oregon

A/Vs:

Georgia, slide/tape (A-17), "Setting Up the Automatic Cutting Machine"

Student Manuals:

Georgia, Welding, Phase A, Unit A-17

Equipment:

a. Oxyacetylene straight line automatic cutting machine
b. Radius rod attachment
c. Mild steel plate, various gages

CLASSROOM HOURS

8

EVALUATION (WL-22)

Given a straight line automatic cutting machine and proper materials, the student will accurately
a. Set up machine;
b. Make three straight, smooth, slag free cuts;
c. Insert radius rod;
d. Cut out one smooth, slag free circle;
e. Cut one smooth, even, beveled edge; and
f. Shut down machine.

INSTRUCTIONAL ACTIVITIES

j. Cutting a straight line
    1. Assembling with correct torches and tips
    2. Starting machine - operating controls
k. Circle cutting
    - Inserting radius rod
l. Bevel cutting

TASK

WL-23 Welding beads with brass rods using oxyacetylene welding equipment

PERFORMANCE OBJECTIVE

Using oxyacetylene welding apparatus and brass rods, the student will demonstrate proper procedure for running beads on steel plate.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Definition of brazing
b. How brazing works
c. Repairing
d. Joining certain metals
  - Cast iron
  - Malleable brass
  - Copper
  - Steel tubing to cast iron
  - Copper tubing to steel
  - Tool steel to low carbon steel
e. Advantages and disadvantages
f. Purpose and use of flux
g. Tip selection

(Continued on back)

Provide Demonstration On:

a. Examples of different uses of brazing
b. Proper brazing technique
c. Errors and their causes

Provide Practical Application On:

a. Braze beads on steel plate.
b. Braze copper tubing to steel plate.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Georgia, Welding, Instructor Guide
b. Giachino and Weeks
c. Griffin, Basic Oxyacetylene
d. Althouse
e. Oregon

A/Vs:

a. Georgia, slide/tape (A-18), "Running Beads With A Brass Rod"

(Continued on back)

Student Manuals:

a. Georgia, Metal Fabrication Cluster, PLACE Package Title No. BW-1
b. Georgia, Welding, Phase A, Unit A-18

Tools and Equipment:

a. Oxyacetylene welding apparatus
b. Flux coated brass rods
c. Mild steel plate 1/8" thick
d. Pieces of copper tubing

CLASSROOM HOURS

CLASSROOM HOURS	4

EVALUATION (WL-23)

a. Given oxyacetylene welding equipment and brass rods and materials, the student will accurately
   1. Set up welding equipment; and
   2. Run two 9" long beads on 2" wide steel plate according to proper specifications.

   Good brazing welds should be as strong as the base metal.

b. Georgia Welding, Instructor Guide, Vol. II, Written Test A-18.

c. Georgia, Metal Fabrication Cluster, Teachers Edition.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

h. Brazing rod selection
i. Brazing technique
   1. Torch adjustment
   2. Tinning
   3. Rod angle
   4. Torch angle, motion and speed
   5. Temperature control
j. Errors and their causes

INSTRUCTIONAL MATERIALS

A/Vs:

b. Prentice-Hall, filmstrip #XF964-6 "Oxyacetylene Welding"; film loop #XF72003-100, "Oxyacetylene Welding"

TASK

WL-24 Brazing a lap joint using oxyacetylene apparatus

PERFORMANCE OBJECTIVE

Demonstrate ability to braze lap joints with uniform appearance and correct depth of bond.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

Bronzing process
- a. Tip selection
- b. Tinning action
- c. Control of flow of filler metal
- d. Types of filler metals
- e. Cleaning surface to be welded

Provide Demonstration On:

Brazing a lap joint

Provide Practical Application On:

Weld unlike metals.

INSTRUCTIONAL MATERIALS

Textbooks:

- a. Georgia, Welding, Instructor Guide
- b. Giachino and Weeks
- c. Griffin, Basic Oxyacetylene
- d. Althouse
- e. Oregon

A/Vs:

Prentice-Hall, filmstrip #XF964-6 "Oxyacetylene Welding"; film loop #XF72003-100, "Oxyacetylene Welding"

Student Manual:

- a. Georgia, Metal Fabrication Cluster, PLACE Packaged Title No. BW-5
- b. Georgia, Welding, Phase A, Unit A-19

Tools and Equipment:

- a. Oxyacetylene welding equipment
- b. 3/32" or 1/8" flux coated brass rod
- c. 4 pieces 1/16" or 1/8" steel 2" x 6"

CLASSROOM HOURS

5

EVALUATION (WL-24)

a. Given oxyacetylene welding equipment, flux coated brass rods and proper materials, the student will accurately set up equipment and braze two joints with proper appearance. One joint will be checked for appearance and one joint will be checked by breaking for depth of bond.

b. Georgia, Welding, Instructor Guide, Vol. II, Written Test A-19.

c. V'TECS, Welding, Task No. 40.

d. Georgia, Metal Fabrication Cluster, Teachers Edition.

TASK

WL-25 Brazing with silver using oxyacetylene equipment

PERFORMANCE OBJECTIVE

Silver braze various metals using oxyacetylene equipment.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Grades of silver alloy
   1. Easy flow
   2. Medium flow
   3. Hard flow
b. Characteristics
   1. Low tensile strength
   2. Corrosion resistance
   3. High electrical conductivity
c. Silver alloys chart
   1. Composition
   2. Melting/flowing point
   3. Uses
   4. Special alloys

(Continued on back)

Provide Demonstration On:

a. Examples of good and bad brazing
b. Proper brazing procedures

Provide Practical Application On:

Silver braze various metals and types of joints.

INSTRUCTIONAL MATERIALS

Textbooks:

Oregon

Tools and Equipment:

a. Oxyacetylene welding apparatus
b. Parts to be brazed
c. Flux
d. Silver brazing filler metal (wire or ribbon)
e. Assorted tools

CLASSROOM HOURS 5

EVALUATION (WL-25)

Given proper silver brazing materials and equipment, the student will accurately braze a proper lap joint that has a good clean appearance. The joint will be tested for strength.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

d. Uses of silver brazing
    1. Fastening carbide inserts
    2. Assembling computer parts
    3. Connecting pipe and tubing
    4. Assembling small stamped parts
    5. Fabricating fire arm parts
    6. Jewelry and artwork
    7. Fabricating odd parts
e. Method of brazing
    1. Preparing metals
    2. Fluxing
    3. Flame adjustment
    4. Using the filler metal
    5. Using the torch
f. Toxic fumes

TASK

WL-26 Soldering

PERFORMANCE OBJECTIVE

Solder copper, sheet metal and other metals using oxyacetylene equipment.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Uses of soldering
b. Types of solder
    - Tin and lead
    - Silver
c. Types of fluxes and their uses
    1. Corrosive
    2. Non-corrosive
d. Advantages and disadvantages of soldering
e. Types of joints
    1. Tolerance
    2. Strength
    3. Joint design

(Continued on back)

Provide Demonstration On:

a. Examples of good soldered joints
b. Examples of soldering errors and their causes
c. Proper soldering technique

Provide Practical Application On:

Solder various metals and different kinds of joints using various types of solder.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Georgia, Welding, Instructor Guide
b. Althouse
c. Oregon

A/Vs:

Georgia, slide/tape (A-20), "Silver Soldering Process"

Student Manuals:

Georgia, Welding, Phase A, Unit A-20

Tools and Equipment:

a. Oxyacetylene welding equipment
b. Solder, various types
c. Flux
d. Various metals to be soldered
e. Assorted tools

CLASSROOM HOURS

5

EVALUATION (WL-26)

a. Given copper tubing, steel sheet metal, solder and oxyacetylene welding equipment, the student will accurately solder two pieces of copper tubing to a piece of sheet metal. Joints must have an even bond around the tubing inside and outside the joint.

b. V'TECS, Welding, Task No. 5o.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Soldering equipment
    1. Soldering copper
    2. Electric soldering copper
    3. Electric soldering gun
    4. Gas furnaces for heating soldering coppers
    5. Propane torch

g. Cleaning and soldering a joint
    1. Heating the base metal
    2. Tinning a copper
    3. Fluxing
    4. Applying solder

h. Soldering technique
    1. Soldering seams
    2. Sweat soldering
    3. Wire connections

TASK

WL-27 Welding cast iron using oxyacetylene apparatus

PERFORMANCE OBJECTIVE

Demonstrate an ability to weld cast iron using oxyacetylene apparatus.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Preparation of casting
    1. Remove "Casting Skin"
    2. Grinding a V
b. Welding process
    1. Fusion - heat metal to melting point to start weld
    2. Flame - neutral
    3. Flux
    4. Angle and motion of torch
c. Post heat and cooling process
    - Cooling slowly
d. Errors and their causes

Provide Demonstration On:

Welding a cast iron butt joint.

Provide Practical Application On:

Braze cast iron.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Georgia, Welding, Instructor Guide
b. Giachino and Weeks
c. Althouse

A/Vs:

Georgia, slide/tape (A-21), "Welding in Cast Iron"

Student Manual:

Georgia, Welding, Phase A, Unit A-21

Equipment:

a. Oxyacetylene welding apparatus
b. Two pieces of cast iron
c. Cast iron filler rod with flux
d. Assorted tools

CLASSROOM HOURS 10

EVALUATION (WL-27)

a. Given oxyacetylene welding apparatus, cast iron, cast iron filler rod, flux and other proper equipment, the student will accurately weld a cast iron butt joint. The joint must have correct penetration and be uniform appearance.

b. V'TECS, Welding, Task No. 45.

TASK

WL-28 Cutting and welding pipe using oxyacetylene apparatus

PERFORMANCE OBJECTIVE

Demonstrate an ability to cut and weld pipe using oxyacetylene apparatus.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Method for cutting pipe
    1. Wrap around - to maintain straight line
    2. Marking pipe with soap stone
    3. Punch on line every 1/2"
    4. Using channel
    5. Proper tip sizes
    6. Torch angle and motion
    7. Flame - neutral
    8. Pipe cutting technique
b. Beveling pipe
    - Torch angle and motion
c. Selecting filler rod

(Continued on back)

Provide Demonstration On:

a. Examples of good welds
b. Examples of errors and their causes
c. Proper welding technique

Provide Practical Application On:

Cut pipe and make a butt weld.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Georgia, Welding, Instructor Guide
b. Giachino and Weeks
c. Althouse
d. Oregon

A/Vs:

Georgia, slide/tape (A-22), "Pipe Welding"

Student Manuals:

Georgia, Welding, Phase A, Unit A-22

Equipment:

a. Oxyacetylene welding apparatus
b. Filler rod
c. Pieces of pipe
d. Assorted tools

CLASSROOM HOURS 5

EVALUATION (WL-28)

a. Given oxyacetylene welding equipment, pipes and other proper equipment, the student will accurately make butt welds on pipe 2" and smaller in the rolled and fixed position. The welds must have correct penetration and bead appearance.

b. V'TECS, Welding, Task No. 83.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

d. Welding pipe
    1. Preparing and positioning pieces of pipe
    2. Rolling method
    3. Angle and motion of torch
    4. Using the filler rod

TASK

WL-29 Selecting and setting up shielded arc welding apparatus

PERFORMANCE OBJECTIVE

Select and set up shielded arc welding apparatus.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Shielded arc welding terminology
b. Safety regulations and practices
c. What to do in case of accident
d. Types and characteristics of arc welding machines and their applications
e. Welding circuits and currents
    1. AC/DC
    2. Amps, volts, ohms
    3. Polarity
    4. Grounding
f. Accessories and protective clothing

(Continued on back)

Provide Demonstration On:

a. Types of welding machines and accessories
b. Safe and unsafe practices

Provide Practical Application On:

a. Set up proper welding circuits.
b. Identify and select electrodes.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Georgia, Welding, Instructor Guide
b. Giachino and Weeks
c. Althouse
d. Oregon
e. Griffin, Basic Arc Welding

A/Vs:

a. Georgia, slide/tape (B-1), "Introduction to Shielded Arc Welding"

(Continued on Back)

Student Manuals:

a. Georgia, Metal Fabrication Cluster, PLACE Package Title No. AW-1
b. Georgia, Welding, Phase B, Units B-1, B-2, B-3, B-4A, B-5, B-6 and B-9

Tools and Equipment:

a. Several types of shielded arc welding machines

(Continued on back)

CLASSROOM HOURS 10

EVALUATION (WL-29)

a. Given a set of job specifications, the student will correctly select and set up the proper arc welding apparatus for performing the job, including selection of the proper electrodes and setting up the welding circuit.

b. Georgia, Welding, Instructor Guide, Vol. II, Written Tests B-1, B-2, B-4A, B-4B and B-5.

c. Georgia, Metal Fabrication Cluster, Teachers Edition.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

g. Procedures for setting up apparatus
h. Types of electrodes, their characteristics and uses
    1. Electrode identification and operating data chart
    2. AWS classification system for mild and low alloy steel electrodes
i. Selecting the correct electrode
    1. Finished product specifications
    2. Job conditions and requirements
    3. The effects of current
    4. Properties of metals being welded

INSTRUCTIONAL MATERIALS

A/Vs:

b. Georgia, slide/tape (B-2), "Shielded Arc Welding Safety"
c. Georgia, slide/tape (B-3), "Identification of Arc Welding Machines"
d. Georgia, slide/tape (B-4), "Electrical Circuits"
e. Georgia, slide/tape (B-6), "Setting up Welding Machine and Striking an Arc"
f. Georgia, slide/tape (B-9), "Identifying and Selecting Electrodes"
g. Bergwall, filmstrip #904 "Electric Arc Welding Explained"
h. Prentice-Hall, filmstrip #F963-1,2, "Arc Welding"

Tools and Equipment:

b. Arc welding face shield
c. Variety of electrodes
d. Chipping hammer
e. Wire brush
f. Soap stone

TASK

WL-30 Welding string and weave beads using shielded arc welding apparatus

PERFORMANCE OBJECTIVE

Weld string and weave beads in all four positions (flat, vertical, horizontal and overhead) using shielded metal arc apparatus.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Uses of string and weave beads
b. Selection of electrode
c. Setting of polarity and amperage
d. Preparation of metals
   1. Cleaning
   2. Laying out lines
   3. Clamping, bracing
e. Setting up circuit
f. Method of welding
   1. Striking an arc
   2. Angle of electrode
   3. Arc length
   4. Motion of electrode
   5. Direction of travel and speed
   6. Tacking

(Continued on back)

Provide Demonstration On:

a. The correct appearance of properly welded string and weave beads
b. Recognizing faulty welding and its cause

Provide Practical Application On:

Weld beads in all four positions using various types of electrodes and metals.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Georgia, Welding, Instructor Guide
b. Giachino and Weeks
c. Oregon
d. Griffin, Basic Arc Welding

A/Vs:

a. Georgia, slide/tape (B-23) "Weld String and Weave Beads in the Overhead Position"

(Continued on back)

Student Manuals:

Georgia, Welding, Phase B, Units B-23, B-24, B-34, B-37

Tools and Equipment:

a. AC/DC welding machine
b. Protective clothing
c. Cleaning tools
d. Pliers or vise grips
e. Various electrodes
f. Various gages of mild steel plate

CLASSROOM HOURS

10

EVALUATION (WL-30)

Given various gages of mild steel plate and arc welding apparatus, the student will correctly set up the equipment, select the proper electrode and weld a series of string and weave beads on plates in the four welding positions of flat, horizontal, vertical and overhead.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

g. Standard for weld
    1. Bead width
    2. Rippling
    3. Uniformity
h. Errors and their causes
    1. Cold start
    2. Burn through
    3. Spattering
    4. Too high crown
    5. Break in arc
i. Cleaning finished work
j. Differences in welding procedures for flat, horizontal, vertical and overhead welding positions
k. Welding characteristics of different gage metals

INSTRUCTIONAL MATERIALS

A/Vs:

b. Bergwall, filmstrip #904-4 and 904-5, "Electric Arc Welding Explained"
c. Prentice-Hall, filmstrip #XFJH2901, "Basic Electric Arc Welding"

TASK

WL-31 Arc welding string beads and padding a plate

PERFORMANCE OBJECTIVE

Arc weld a pad of overlapping beads in the flat, vertical, horizontal and overhead positions using E6010, E6011 and E6013 electrodes.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Definitions
   1. Padding a plate
   2. Beads
   3. Wash beads
   4. Tolerance
   5. Shelf
   6. Sagging
   7. Undercutting
b. Method of making a pad of beads
   1. Motion of weld
      - Straight back and forth
      - Hooking
      - Circular

(Continued on back)

Provide Practical Application On:

Weld a pad of beads.
a. Weld in all four positions.
b. Use E6010, E6011 and E6013 electrodes.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Georgia, Welding, Instructor Guide
b. Giachino and Weeks
c. Althouse
d. Oregon
e. Griffin, Basic Arc Welding

A/Vs:

a. Georgia, slide/tape (B-7), "Welding a Pad of Beads in the Flat Position"

(Continued on back)

Student Manuals:

a. Georgia, Metal Fabrication Cluster, PLACE Package Title No. AW-2
b. Georgia, Welding, Phase B, Units B-7, B-12, B-16, B-18

Tools and Equipment:

a. AC/DC welding machine
b. Protective clothing
c. Cleaning tools

(Continued on back)

CLASSROOM HOURS

10

EVALUATION (WI-31)

a. Given shielded arc welding equipment and other proper materials, the student will accurately weld a pad of beads by
   -Welding a pad of beads in all four positions.
   -Using different electrode types.

b. Beads should have proper width, eveness, uniformity, no cold starts, proper crater filling, correct overlapping and no sag or undercut.

c. Georgia, Metal Fabrication Cluster, Teachers Edition.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

  2. Welding in the four positions (flat, vertical, horizontal, and overhead)
     - Arc length
     - Speed of travel
     - Angle of electrode
     - Amperage

c. Adjusting machine
  1. Electrode types (particularly E6010, E6011 and E6013 electrodes
  2. Thickness of metal

d. Cleaning work

INSTRUCTIONAL MATERIALS

A/Vs:

b. Prentice-Hall, filmstrip #XF963-3 "Arc Welding"; film loop #XFJH2902 "Basic Electric Arc Welding"
c. Georgia, slide/tape (B-16) "Padding a Plate of Beads in the Horizontal Position"
d. Georgia, slide/tape (B-18), "Padding a Plate in the Vertical Position"

Tools and Equipment:

d. Pliers or vise grips
e. 1/8" E6010, E6011, E6013 electrodes
f. 1/4" mild steel plates 5" x 8"

TASK

WL-32 Arc welding lap joints

PERFORMANCE OBJECTIVE

Shield arc weld lap joints in the flat, horizontal, vertical and overhead positions using E6010, E6011, E6012, E6013 electrodes and different gage metals.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Lap joints
   1. Edge preparation
   2. Positioning of metals
   3. Leg dimensions
b. Bead form for lap joints
c. Method for welding various gages of metals
   1. Electrode selection
   2. Welding together two different gages of metals
   3. Welding together the same gage of metal
   4. Where to direct arc
d. Welding positions
   1. Flat
   2. Horizontal

(Continued on back)

Provide Demonstration On:

a. Examples of good lap joint welds
b. Errors and their causes
c. Proper welding technique

Provide Practical Application On:

a. Examples of good lap joint welds
b. Errors and their causes
c. Proper welding technique

INSTRUCTIONAL MATERIALS

Textbooks:

a. Georgia, Welding, Instructor Guide
b. Althouse
c. Oregon
d. Schell and Matlock
e. Griffin, Basic Arc Welding

A/Vs:

a. Georgia, slide/tape (B-10), "Welding a Lap Joint in the Horizontal Position"

(Continued on back)

Student Manuals:

a. Georgia, Metal Fabrication Cluster, PLACE Package Title No. AW-7
b. Georgia, Welding, Phase B, Units B-10, B-14, B-20, B-25, B-36, B-39

Tools and Equipment:

a. Sheilded arc welding machine
b. Protective clothing
c. Cleaning tools

(Continued on back)

CLASSROOM HOURS

10

EVALUATION (WL-32)

a. Given shielded arc welding equipment and other proper materials, the student will accurately weld lap joints by
   -Welding in the four welding positions.
   -Welding the joint using two different gages of metal to weld together.
   -Welding different gages of metal, but weld the same gage together.

b. Joint should have proper penetration and fusion, complete fill, equal leg dimensions, proper beads and a clean neat appearance.

c. V'TECS, Welding, Task No. 24.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

   3. Vertical
   4. Overhead
- e. Welding method for the four positions
   1. Motion of electrode
   2. Torch angle and motion
   3. Machine settings
   4. Travel speed
- f. Welding with different electrodes
   1. Method of selection and identification
   2. Machine settings
   3. Current
   4. Travel speed
   5. Types of metals used with electrodes
   6. Electrode widths
- g. Errors
   1. Weld sag
   2. Undercut
   3. Burn through
- h. Testing weld joints
   1. Guided bend testing
   2. Acid etching
   3. Destructive tests
   4. X-ray tests
   5. Visual tests

INSTRUCTIONAL MATERIALS

A/Vs:

b. Bergwall, filmstrip #904B-6 "Positional Welding"
c. Prentice-Hall, filmstrip #XF963-3 "Arc Welding"

Tools and Equipment:

d. Pliers and vise grips
e. Electrodes E6010, E6011, E6012, E6013, E6024, E7024, and E7018
f. Light and medium gage metal

TASK

WL-33 Arc welding butt joints

PERFORMANCE OBJECTIVE

Shield arc weld butt joints in the flat, horizontal, vertical and overhead positions using E6010, E6011, E6012, E6013, E6024, E7018 and E7024 electrodes and different gage metals.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types of butt joints
   1. Square butt
   2. Square groove
   3. Single V groove
   4. Double V groove
   5. Single bevel groove
   6. Double bevel groove
   7. Single U groove
   8. Double U groove
   9. Single J groove
   10. Double J groove
b. Edge preparation
c. Root opening
d. Bead form and sequence
e. Back up bar
f. Welding different gages of metals

(Continued on back)

Provide Demonstration On:

a. Different types of electrodes and their uses with butt joints
b. Examples of good butt joint welds
c. Examples of poor butt joint welds and the causes

Provide Practical Application On:

Weld butt joints in the four positions using different metals and different electrodes.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Giachino and Weeks
b. Althouse
c. Oregon
d. Schell and Matlock
e. Georgia, Welding, Instructor Guide
f. Griffin, Basic Arc Welding

A/Vs:

(Continued on back)

Student Manuals:

a. Georgia, Metal Fabrication Cluster, PLACE Package Title No. AW-5, AW-9
b. Georgia, Welding, Phase B, Units B-8, B-13, B-17, B-19, B-24, B-27, B-30, B-32, B-35 and B-38

Tools and Equipment:

a. Shielded arc welding machine and apparatus

(Continued on Back)

CLASSROOM HOURS

10

EVALUATION (WL-33)

a. Given a shielded arc welding machine and related apparatus and tools, the student will accurately weld various types of square and grooved butt joints in the four positions of flat, horizontal, vertical and overhead, using E6010, E6011, E6012, E6013, E6024, E7018 and E7024 electrodes and various gages of metals. All joints will be free of errors and poor welds.

b. V'TECS, Welding, Task Nos. 18, 20, 21, 22 and 23.

c. Georgia, Metal Fabrication Cluster, Teachers Edition.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

g. Welding in different positions
    1. Flat
    2. Horizontal
    3. Vertical
    4. Overhead
h. Welding techniques
    1. Motion of electrode
    2. Electrode angle
    3. Direction of travel
    4. Machine settings
    5. Arc length
i. Errors and their causes
    1. Weld sag
    2. Undercut
    3. Spattering
    4. Cold start
    5. Burn through
j. Using different electrodes
    1. Machine settings
    2. Travel speed
    3. Electrode diameter
    4. Matching with metals
    5. Welding with E6010, E6011, E6012, E6013, E6024, E7018 and E7024 electrodes
k. Testing weld joints
l. Characteristics of good joints

INSTRUCTIONAL MATERIALS

A/Vs:

a. Georgia, slide/tape (B-8), "Welding Butt Joints in the Flat Position"
b. Bergwall, filmstrip #904B, "Positional Welding"
c. Prentice-Hall, filmstrip #XF963-5 "Arc Welding"; film loop #XFJH2908, 11, 12, 13 "Basic Electric Arc Welding"

TASK

WL-34 Shield arc welding T-fillet joints

PERFORMANCE OBJECTIVE

Shield arc weld T-fillet joints in the flat, horizontal, vertical and overhead positions using E6010, E6011, E6013, E7018 and E7024 electrodes.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Terminology
   1. Fillet joint
   2. T-fillet joint
   3. Root beads
   4. Weave beads
   5. Multiple passes
   6. Keyhole effect
b. Welding techniques
   1. Machine setting
   2. Electrode angle
   3. Electrode motion
   4. Arc length
   5. Speed of travel
   6. Direction of travel
c. Selection of electrodes
d. Low hydrogen electrodes

(Continued on back)

Provide Demonstration On:

a. Examples of properly welded joints
b. Examples of poor welding and the causes

Provide Practical Application On:

Weld T-joints in the four welding positions using various metals and various electrodes.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Giachino and Weeks
b. Althouse
c. Oregon
d. Schell and Matlock
e. Georgia, Welding, Instructor Guide
f. Griffin, Basic Arc Welding

A/Vs:

a. Bergwall, filmstrip #904B, "Positional Welding"

(Continued on back)

Student Manuals:

a. Georgia, Metal Fabrication Cluster, PLACE Package Title No. AW-6, AW-10, AW-11
b. Georgia, Welding, Phase B, Units B-11, B-15, B-21, B-22, B-26, B-31 and B-33

Tools and Equipment:

a. AC/DC welding machine and apparatus

(Continued on back)

CLASSROOM HOURS 10

EVALUATION (WL-34)

a. Given an AC/DC shielded arc welding machine, related apparatus and tools, the student will accurately weld T-fillet joints in the flat, horizontal, vertical and overhead positions using various gages of mild steel plate and a variety of different electrodes. All welds will exhibit the characteristics of a good weld and will be free of errors.

b. V'TECS, Welding, Task No. 17.

c. Georgia, Metal Fabrication Cluster, Teachers Edition.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

e. Bead type and distribution
f. Welding in different positions
g. Errors and their causes

INSTRUCTIONAL MATERIALS

A/Vs:

b. Prentice-Hall, filmstrip #XF963-5 "Arc Welding"; film loop #XFJH2904, 9, 14 "Basic Electric Arc Welding"

Tools and Equipment:

b. Protective clothing
c. Assorted tools
d. Electrodes E6010, E6011, E6013, E7018 and E7024
e. Various gages of mild steel plate

TASK

WL-35 Testing arc welded joints

PERFORMANCE OBJECTIVE

Test arc welded joints using the break test and the guided bend test.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Conducting the break test
b. Characteristics of a good break
    1. Face smooth and regular
    2. Complete fusion, full penetration
    3. No undercutting
    4. No slag or gas pockets in weld
c. Conducting the guided bend test
    1. Face bend
    2. Root bend

Provide Demonstration On:

a. Conducting joint tests
b. Examples of good welds

Provide Practical Application On:

a. Conduct break and bend tests.
b. Conduct sawed cross-section test.
c. Conduct chisel test.

(Continued on back)

INSTRUCTIONAL MATERIALS

Textbooks:

a. Giachino and Weeks
b. Griffin, Basic Arc Welding
c. Althouse
d. Oregon
e. Georgia, Welding, Instructor Guide

Student Manuals:

Georgia, Welding, Phase B, Unit B-40

Tools and Equipment:

a. Arc welded T-joints
b. Arc welded butt joints
c. Pliers, vise grips, bench vice
d. Hacksaw
e. Hammer, chisels, punch

CLASSROOM HOURS 8

EVALUATION (WL-35)

a. Given an AC/DC shielded arc welding machine, electrodes, metal plates and assorted tools, the student will accurately weld several T-joints and V-groove butt joints and will test the joints using break tests, bend tests, saw tests and chisel tests.

b. V'TECS, Welding, Task No. 29.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

d. Characteristics of a good bend
    1. No cracks or breaks
    2. Complete fusion
e. Conducting a sawed cross-section test
f. Conducting a chisel test

TASK

WL-36 Identifying and describing tungsten inert gas (TIG) welding processes

PERFORMANCE OBJECTIVE

Demonstrate a knowledge of tungsten inert gas arc welding applications, advantages and terminology.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Terminology
   1. Tig welding
   2. Tungsten electrode
   3. Inert gas shielding
   4. High frequency current
   5. Flow meter
   6. Collet
   7. Collet body or chuck
   8. Foot control
   9. Gas cup
   10. Porosity
   11. Thermal conductivity
   12. Metallurgy
   13. Aluminum oxide
   14. Alternating current

(Continued on back)

Provide Demonstration On:

TIG welding apparatus and its associated terminology

Provide Practical Application On:

Identify TIG apparatus.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Giachino and Weeks
b. Althouse
c. Schell and Matlock
d. Oregon
e. Georgia, Welding, Instructor Guide
f. Griffin, Basic TIG & MIG Welding

A/Vs:

(Continued on back)

Student Manuals:

a. Georgia, Metal Fabrication Cluster, PLACE Package Title No. TW-1
b. Georgia, Welding, Phase C, Unit C-1

Tools and Equipment:

TIG welding apparatus

CLASSROOM HOURS

7

EVALUATION (WL-36)

a. Given a list of the terms used in TIG welding, the student will correctly match the terms with their correct definition.

b. Georgia, Welding, Instructor Guide, Vol. II, TIG welding test C-1.

c. Georgia, Metal Fabrication Cluster, Teachers Edition.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

15. Direct current straight polarity
16. Direct current reverse polarity
17. Filler rod
b. Application
c. Advantages

INSTRUCTIONAL MATERIALS

A/Vs:

a. Georgia, slide/tape (C-1), "Introduction to Tungsten Inert Gas Welding"
b. Prentice-Hall, filmstrip #XF1169-1 "Gas Shielded Arc Welding (TIG/MIG)"

TASK

WL-37 Following safety procedures and regulations for TIG welding

PERFORMANCE OBJECTIVE

Demonstrate a knowledge of safety hazards, accident prevention, safety regulations and safety equipment.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Hazards
    1. Damage to eyes and skin from infrared and ultraviolet radiation
    2. Hot metals
    3. Toxic fumes and gases
    4. Shock
    5. Fire
    6. Explosions
b. Controlling hazards
    1. Protective clothing
    2. Shop safety habits
    3. Proper ventilation
    4. Clean, neat work area
    5. Maintaining equipment

Provide Demonstration On:

a. Safe and unsafe welding practices
b. Use of the fire extinguishers

Provide Practical Application On:

a. Handling fire extinguishers
b. Demonstrating first aid practices

(Continued on back)

INSTRUCTIONAL MATERIALS

Textbooks:

a. Giachino and Weeks
b. Althouse
c. Schell and Matlock
d. Georgia, Welding, Instructor Guide
e. Griffin, Basic TIG & MIG Welding

Student Manuals:

Georgia, Welding, Phase C, Unit C-2

Tools and Equipment:

a. Welding apparatus
b. Protective clothing
c. First aid supplies
d. Fire extinguishers

CLASSROOM HOURS

4

EVALUATION (WL-37)

a. Given a list of typical TIG welding equipment and practices, the student will correctly identify sources of hazard, precautionary measures to be taken and correct handling of safety equipment.

b. Georgia, Welding, Instructor Guide, Vol. II, TIG welding test C-1.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

    6. Safety devices on equipment
    7. Leak test
c. Classes of fires
d. Types and uses of fire extinguishers
    1. Pressurized water
    2. Soda-acid
    3. Carbon dioxide
    4. Dry chemical
    5. Foam
    6. Dry sand
e. Safety clothing
f. What to do in case of accident
    1. First aid
    2. Summoning aid

TASK

WL-38 Identifying TIG welding equipment

PERFORMANCE OBJECTIVE

Identify all major parts of the equipment used in TIG welding.

INSTRUCTIONAL ACTIVITIES

Provide Information on:

a. Power supply controls
   1. Weld control switch
   2. Current selector
   3. Fine adjustment current control
   4. Polarity switch
   5. High frequency
   6. Gas and water connections
   7. Terminals
   8. Remote control
   9. Shielding gas afterflow timer
   10. Soft start

(Continued on back)

Provide Demonstration On:

Use of the power supply controls

Provide Practical Application On:

Examine and identify the parts of the TIG welding apparatus.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Althouse
b. Giachino and Weeks
c. Schell and Matlock
d. Georgia, Welding, Instructor Guide
e. Griffin, Basic TIG & MIG Welding

A/Vs:

a. Prentice-Hall, filmstrip #XF1169-1, 2, "Gas Shielded Arc Welding (TIG/MIG)"

Student Manuals:

Georgia, Welding, Phase C, Unit C-3

Tools and Equipment:

TIG welding apparatus

CLASSROOM HOURS

3

EVALUATION (WL-38)

a. Given the equipment used in TIG welding, the student will correctly identify the type and use of each piece of equipment and will identify each part of the equipment and its function.

b. Georgia, Welding, Instructor Guide, Volume II, TIG welding test C-3.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

b. Major parts of the TIG torch
    1. Cap
    2. Electrode
    3. Collet
    4. Collet holder
    5. Gas cup
c. Types of cups
    1. Ceramic
    2. Pyrex glass
    3. Metal
d. Types of shielding gas
    1. Argon
    2. Helium
    3. Argon-helium mixes

INSTRUCTIONAL MATERIALS

A/Vs:

b. Prentice-Hall, filmstrip #XF1169-1,2 "Gas Shielded Arc Welding (TIG/MIG)"

TASK

WL-39 Setting up TIG equipment to weld aluminum

PERFORMANCE OBJECTIVE

Set up TIG equipment to weld aluminum.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Setting up the power supply (See Evaluation section for steps)
b. Torch adjustments
    1. Types of electrodes
    2. Preparing the electrode
    3. Collet, collet chuck and cup
    4. Electrode stick-out
c. Connecting ground clamp
d. Aluminum metallurgy
e. Aluminum filler rods
f. Cleaning the metal

Provide Demonstration On:

a. Setting up and adjusting TIG equipment for aluminum
b. Preparing electrodes
c. Types of filler rods

Provide Practical Application On:

a. Set up and adjust TIG equipment for welding aluminum.
b. Prepare electrodes.
c. Leak testing.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Althouse
b. Giachino and Weeks
c. Schell and Matlock
d. Georgia, Welding, Instructor Guide
e. Griffin, Basic TIG & MIG Welding

A/Vs:

a. Georgia, slide/tape (C-4), "Setting up TIG Equipment to Weld Aluminum"

(Continued on back)

Student Manuals:

a. Georgia, Metal Fabrication Cluster, PLACE Package Title No. TW-2
b. Georgia, Welding, Phase C, Unit C-4

Tools and Equipment:

a. TIG welding equipment
b. Argon
c. Pure or zirconiated tungsten electrodes
d. Filler rods

CLASSROOM HOURS

7

EVALUATION (WL-39)

a. Have student set up and adjust TIG equipment according to the following checklist. Grade each step as either satisfactory (S) or unsatisfactory (U).

STEPS	S	U
1. Set current range selector	( )	( )
2. Fine adjust current	( )	( )
3. Set polarity switch to AC	( )	( )
4. Set weld control switch to TIG	( )	( )
5. Set frequency control	( )	( )
6. Switch power on	( )	( )
7. Mount flowmeter to argon cylinder	( )	( )
8. Leak test	( )	( )
9. Adjust shielding gas flow rate	( )	( )
10. Adjust post purge timer	( )	( )
11. Set soft start to "on"	( )	( )
12. Set foot control switch to remote	( )	( )
13. Select electrode	( )	( )
14. Prepare electrode with shiny balled end	( )	( )
15. Select collet, chuck cup	( )	( )
16. Adjust electrode stick-out	( )	( )
17. Connect ground clamp	( )	( )

b. Georgia , Metal Fabrication Cluster, Teachers Edition.

INSTRUCTIONAL MATERIALS

A/Vs:

b. Prentice-Hall, filmstrip
#XF1169-3 "Gas Shielded
Arc Welding (TIG/MIG)

[illegible]SK

WL-40 Identifying and describing metal inert gas (MIG) welding processes

PERFORMANCE OBJECTIVE

Demonstrate a knowledge of the MIG welding process, safety hazards and precautions.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. MIG welding applications and advantages
b. Major equipment components and functions
    1. Power supply
    2. Wire feed control
    3. Shielding gas source
    4. Welding gun
c. MIG terminology
d. Safety hazards
    1. Electric shock
    2. Radiation burns to eyes
    3. Sources of fire
    4. Danger of explosions
    5. Toxic fumes

(Continued on back)

Provide Demonstration On:

a. MIG welding equipment and its terminology
b. Proper handling of equipment

Provide Practical Application On:

a. Use fire extinguishers.
b. Give first aid simulated welding accidents.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Giachino and Weeks
b. Sacks
c. Schell and Matlock
d. Georgia, Welding, Instructor Guide
e. Griffin, Basic TIG & MIG Welding

A/Vs:

a. Georgia, slide/tape (D-1), "Introduction to Inert Gas Welding"

(Continued on back)

Student Manuals:

Georgia, Welding, Phase D, Units D-1, D-2 and D-3

Tools and Equipment:

a. MIG welding equipment
b. Protective clothing
c. Fire extinguishers

CLASSROOM HOURS

10

EVALUATION (WL-40)

a. The student will accurately match the MIG welding terminology with the MIG welding apparatus and procedures and will identify the sources of hazard associated with MIG welding and the proper precautions or remedies to be taken.

b. Georgia, Welding, Instructor Guide, Vol. II.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

    6. Welding containers that have held combustibles
e. Protective clothing
f. Types and uses of fire extinguishers
g. First aid
h. Good shop practices

INSTRUCTIONAL MATERIALS

A/Vs:

b. Georgia, slide/tape (D-2), "Gas Metal Arc Welding Safety"
c. Georgia, slide/tape (D-3), "Identification of Gas Metal Arc Welding Machines"
d. Prentice-Hall, filmstrip #XF1169-4 "Gas Shielded Arc Welding (TIG/MIG)"

TASK

WL-41 MIG welding beads on mild steel plate

PERFORMANCE OBJECTIVE

MIG weld beads on mild steel plate of various gages.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Setting up the equipment
b. Selecting the electrode
c. Adjusting the contact tip and gas shield
d. Adjusting wire stick-out
e. Setting gas flow
f. Setting wire speed
g. Setting voltage
h. Welding gun movements
    1. Pull
    2. Push
    3. Whip and pause
    4. Straight drag
    5. Semicircular
    6. Circular
    7. Straight weave

(Continued on back)

Provide Demonstration On:

a. Examples of good and bad bead welds
b. Welding errors and their causes
c. Proper welding technique

Provide Practical Application On:

a. Use the different welding techniques.
b. Weld beads on plates of various gages in the four welding positions.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Giachino and Weeks
b. Schell and Matlock
c. Georgia, Welding, Instructor Guide
d. Griffin, Basic TIG & MIG Welding

A/Vs:

a. Georgia, slide/tape (D-4), "Setting Up Machine and Running Beads"

(Continued on back)

Student Manuals:

Georgia, Welding, Phase D, Unit D-4

Tools and Equipment:

a. MIG welding equipment
b. CO_2 shielding gas
c. Protective clothing
d. Mild steel electrode wire
e. Mild steel plate, various gages

CLASSROOM HOURS

15

EVALUATION (WL-41)

The student will MIG weld beads on mild steel plate of various gages. Welds will be made in the flat, horizontal, vertical and overhead positions using the push, pull, whip and pause, straight drag, semicircular, circular and straight weave motions. All welds will be free of errors and flaws.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

i. Characteristics of a good bead weld
j. Errors and their causes
    1. Cold lapping
    2. Excessive penetration
    3. Burn through
    4. Surface porosity
    5. Poor appearance
    6. Whiskers
    7. Bad tie-in
    8. Suck back

INSTRUCTIONAL MATERIALS

A/Vs:

b. Prentice-Hall, filmstrip #XF1169-2 "Gas Shielded Arc Welding (TIG/MIG)"

TASK

WL-42 MIG welding butt joints using mild steel

PERFORMANCE OBJECTIVE

MIG weld butt joints in the flat, horizontal, vertical and overhead positions using mild steel plate.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types of butt joints
    1. Square butt
    2. Square groove
    3. Single and double V groove
    4. Single and double bevel groove
    5. Single and double U groove
    6. Single and double J groove
b. Edge preparation
c. Root opening
d. Keyhole
e. Bead form and sequence
f. Back up bar

(Continued on back)

Provide Demonstration On:

a. Different types of butt joints
b. Examples of good and bad butt welds
c. Proper welding technique
d. Bend testing welds

Provide Practical Application On:

a. Weld butt joints in the four positions using various gages of mild steel plate.
b. Test joints.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Giachino and Weeks
b. Schell and Matlock
c. Georgia, Welding, Instructor Guide
d. Griffin, Basic TIG & MIG Welding

A/Vs:

a. Georgia, slide/tape (D-5), "Weld a Butt Joint in the Flat Position"

(Continued on back)

Student Manuals:

Georgia, Welding, Phase D, Units D-5, D-8, D-9, D-12, D-15, D-16

Tools and Equipment:

a. MIG welding equipment
b. Protective clothing
c. CO_2 shielding gas
d. Mild steel electrode wire
e. Mild steel plate, various gages

CLASSROOM HOURS

10

EVALUATION (WL-42)

a. The student will MIG weld a square butt, a bevel groove, a V groove, a U groove and a J groove butt joint using various gages of mild steel plate. At least one weld will be in each of the four positions. Joints will be bend tested and will be free of errors and flaws.

b. V'TECS, Welding, Task Nos. 18, 21, 22 and 23.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

g. Welding different gage metals
h. Welding technique
    1. Tacking
    2. Torch angle and motion
    3. Arc length
    4. Gas flow
    5. Wire speed
    6. Voltage
i. Characteristics of good butt welds
j. Single pass and multiple pass welds
k. Errors and their causes

INSTRUCTIONAL MATERIALS

A/Vs:

b. Georgia, slide/tape (D-9), "Weld a Butt Joint in the Vertical Position"
c. Prentice-Hall, filmstrip #XF1169-2 "Gas Shielded Arc Welding (TIG/MIG)"

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TASK

WL-43 MIG welding lap joints using mild steel plate

PERFORMANCE OBJECTIVE

MIG weld lap joints in the flat, horizontal, vertical and overhead positions using mild steel plate.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Edge preparation
b. Selecting the electrode wire
c. Setting up the equipment
d. Adjusting gas flow, voltage and wire speed
e. Tacking
f. Gun motion and speed
g. Bead form and sequence
h. Welding different gage metals
i. Characteristics of good lap welds
j. Errors and their causes

Provide Demonstration On:

a. Examples of good and bad lap joint welds
b. Errors and their causes
c. Proper welding technique

Provide Practical Application On:

a. Weld lap joints in the four positions using various gage metals.
b. Test joints.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Giachino and Weeks
b. Schell and Matlock
c. Georgia, Welding, Instructor Guide
d. Griffin, Basic TIG & MIG Welding

A/Vs:

Georgia, slide/tape (D-6), "Weld a Lap Joint in the Horizontal Position"

Student Manuals:

Georgia, Welding, Phase D, Unit D-6

Tools and Equipment:

a. MIG welding equipment
b. CO_2 shielding gas
c. Assorted tools
d. Mild steel electrode wire
e. Mild steel plate, various gages
f. Protective clothing

CLASSROOM HOURS

10

EVALUATION (WL-43)

a. The student will MIG weld lap joints in the flat, horizontal, vertical and overhead positions using various gages of mild steel plate. Welds will be bend tested and will be free of flaws and errors.

b. V'TECS, Welding, Task No. 24.

TASK

WL-44 MIG welding fillet joints using mild steel plate

PERFORMANCE OBJECTIVE

MIG weld fillet joints in the flat, horizontal, vertical and overhead positions using mild steel plate.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types of fillet joints
b. Edge preparation
c. Positioning of metals
d. Selecting the electrode wire
e. Setting up the equipment
f. Weld method for the four positions
    1. Tacking
    2. Bead form and sequence
    3. Gun angle and motion
    4. Gas flow, voltage, amperage
g. Welding with various gage metals
h. Characteristics of good fillet welds
i. Errors and their causes

Provide Demonstration On:

a. Different types of fillet joints
b. Examples of good and bad welds
c. Proper welding technique

Provide Practical Application On:

Weld fillet joints in the four positions using various gages of mild steel plate.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Giachino and Weeks
b. Schell and Matlock
c. Georgia, Welding, Instructor Guide
d. Griffin, Basic TIG & MIG Welding

Student Manuals:

Georgia, Welding, Phase D, Units D-7, D-10, D-11, D-13 and D-14

Tools and Equipment:

a. MIG welding equipment
b. CO_2 shielding gas
c. Protective clothing
d. Assorted tools
e. Mild steel plate, various gages
f. Mild steel electrode wire

CLASSROOM HOURS

8

EVALUATION (WL-44)

a. The student will MIG weld fillet joints in the flat, horizontal, vertical and overhead positions using mild steel plate of various gages. Welds will be tested and will be free of flaws and errors.

b. V'TECS, Welding, Task No. 17.

TASK

WL-45 MIG welding with stainless steel

PERFORMANCE OBJECTIVE

MIG weld lap joints, butt joints, fillet joints and corner joints using various types and gages of stainless steel plate.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types of stainless steel and their characteristics
    1. Iron and chromium
    2. Nickel addition
    3. Molybdenum addition
    4. Straight chromium
    5. Chromium and nickel
b. Welding metallurgy for stainless steel
    1. Thermal conductivity
    2. Distortion
c. Advantages of MIG welding
d. Selecting the electrode wire
e. Selecting shielding gas
f. Setting gas flow, voltage and amperage

(Continued on back)

Provide Demonstration On:

a. Identifying types of stainless steel
b. Proper welding technique
c. Examples of errors and their causes

Provide Practical Application On:

a. Identify types of stainless steel.
b. Weld all types of joints in different welding positions using various types and gages of stainless steel plate.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Giachino and Weeks
b. Sacks
c. Schell and Matlock
d. Georgia, Welding, Instructor Guide
e. Griffin, Basic TIG & MIG Welding

Student Manuals:

Georgia, Welding, Phase D, Units D-17 and D-18

Tools and Equipment:

a. MIG welding equipment
b. Helium + argon + CO_2 shielding gas
c. ER308 wire electrode
d. Protective clothing
e. Assorted tools
f. Stainless steel plate, various types and gages

CLASSROOM HOURS

8

EVALUATION (WL-45)

a. The student will MIG weld a variety of different joints in the four welding positions using various types and gages of stainless steel plate. All welds will be free of flaws and errors.

b. V'TECS, Welding, Task No. 58.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

g. Arc length
h. Back up gas shield
i. Copper back up strip
j. Welding technique with stainless steel
k. Welding errors and their causes

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TASK

WL-46 MIG welding with aluminum

PERFORMANCE OBJECTIVE

MIG weld lap joints, butt joints, fillet joints and corner joints using various types and gages of aluminum and aluminum alloy plate.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types of aluminum and aluminum alloys
    1. Straight aluminum
    2. Aluminum-copper
    3. Aluminum-magnesium
    4. Aluminum-manganese
    5. Aluminum-silicon
    6. Aluminum-zinc
b. Welding metallurgy for aluminum
c. Joint preparation
d. Cleaning the metals
e. Electrode wire selection
f. Shielding gas selection
g. Back up shielding

(Continued on back)

Provide Demonstration On:

a. Identifying aluminum and aluminum alloys
b. Proper welding technique
c. Examples of errors and their causes

Provide Practical Application On:

a. Identify aluminum and aluminum alloy metals.
b. Weld all types of joints in different positions using various gages of aluminum and aluminum alloys.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Giachino and Weeks
b. Sacks
c. Schell and Matlock
d. Georgia, Welding, Instructor Guide
e. Griffin, Basic TIG & MIG Welding

Student Manuals:

Georgia, Welding, Phase D, Units D-19 and D-20

Tools and Equipment:

a. MIG welding equipment
b. Argon shielding gas
c. ER4043 and ER1100 electrode wire
d. Protective clothing
e. Assorted tools
f. Aluminum and aluminum alloy plates of various gages

CLASSROOM HOURS 8

EVALUATION (WL-46)

The student will MIG weld a variety of different joints in the four welding positions using aluminum and aluminum alloys of various gages. All welds will be free of flaws and errors.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

h. Setting gas flow, voltage and amperage
i. Arc length
j. Welding technique for various joints, positions, gages and types of metals

TASK

MS-01 Identifying parts and functions of the drilling machine

PERFORMANCE OBJECTIVE

Identify the parts of a drilling machine and describe their operations.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Parts of the upright drill press
b. Purpose of the parts
c. Functions of the drill press
d. Safety

Provide Demonstration On:

Operating a drill press

Provide Practical Application On:

Identify the parts of the drill press and explain what each part does.

INSTRUCTIONAL MATERIALS

Textbocks:

a. Burghardt, Part I
b. Kibbe
c. Porter

A/Vs:

Prentice-Hall, filmstrip #XF929-1, "Machine Shop: Drill Press"

Student Manuals:

a. Georgia, Metal Fabrication Cluster, PLACE Package Title No. EP-1
b. Ohio, Machine Trades I, Drilling Machine Work Assignment Sheet #1

Tools and Equipment:

Upright drill press

CLASSROOM HOURS

2

EVALUATION (MS-01)

a. Given an upright drill press, the student will accurately identify each part and describe its function.

b. Georgia, Metal Fabrication Cluster, Teachers Edition.

TASK

MS-02 Identifying safety practices and precautions when using the drilling machine

PERFORMANCE OBJECTIVE

Identify safety practices and precautions on a drilling machine.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Using clamps
b. Broken bits
c. Turning workpiece due to "grabbing" drill bit
d. Keeping drill press table clean of tools
e. Lifting heavy pieces
f. Removing chuck key
g. Hand safety
h. Eye safety
i. Head safety

Provide Practical Application On:

Demonstrate safe drilling machine practice by choosing appropriate safety gear and demonstrate safe working practices.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Porter
c. Kibbe

A/Vs:

Prentice-Hall, filmstrip #XF929-1, "Machine Shop: Drill Press"

Student Manuals:

Ohio, Machine Trades I, Drilling Machine Work Assignment #2

Tools and Equipment:

a. Safety goggles or face shield
b. Safety hat

CLASSROOM HOURS 2

EVALUATION (MS-02)

Given a drilling machine and appropriate safety gear, the student will demonstrate correct safety precautions by choosing the appropriate safety gear and demonstrating safe operating practices.

TASK

MS-03 Identifying work holding devices and setups

PERFORMANCE OBJECTIVE

Identify work holding and locating device used on drilling machines.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Purpose of work holding devices
b. Methods
    1. T-bolts and clamps
    2. Parallels
    3. C-clamps
    4. Angle plates
    5. Drill press vises
    6. Cold finished key stock
    7. Vee-blocks
c. Safety

Provide Demonstration On:

Using T-bolts and clamps to hold work down on the drill press

Provide Practical Application On:

a. Use T-bolts and clamps to hold work on the drill press.
b. Identify various types of drill press work holding devices.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

A/Vs:

Prentice-Hall, filmstrip #XF929-1, "Maching Shop: Drill Press"

Student Manuals:

a. Georgia, Metal Fabrication Cluster, PLACE Package Title No. DP-4
b. Ohio, Machine Trades I, Drilling Machine Work Assignment Sheet #3

Tools and Equipment:

a. T-bolts
b. Clamps
c. Parallels

(Continued on back)

CLASSROOM HOURS

2

EVALUATION (MS-03)

a. Given a selection of drill press work holding devices, the student will accurately identify each device and will be able to locate and bolt down a workpiece on the press using T-bolts and clamps.

b. Georgia, Metal Fabrication Cluster, Teachers Edition.

INSTRUCTIONAL MATERIALS

Tools and Equipment:

d. C-clamps
e. Angle plates
f. Drill press vises
g. Vee-blocks

TASK

MS-04 Identifying and using drill bit holding devices

PERFORMANCE OBJECTIVE

Identify and be able to use drill bit holding devices on the drilling machine.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Drill chuck
b. Shank
c. Tang on tapered shanks
d. Drift or key
e. Drill bit holding devices
f. Safety

Provide Demonstration On:

Mounting a drill bit on the drilling machine

Provide Practical Application On:

Mount a drill bit on the drilling machine.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

A/Vs:

Prentice-Hall, filmstrip #XF929-2, "Machine Shop: Drill Press"

Student Manuals:

Ohio, *Machine Trades I*, Drilling Machine Work Assignment Sheet #4

Tools and Equipment:

a. Drill bit
b. Drilling machine
c. Chuck

CLASSROOM HOURS

2

EVALUATION (MS-04)

a. Given a drilling machine, drill bit and chuck, the student will accurately follow procedures to mount a drill bit on the drilling machine. The student must observe all safety precautions.

b. V'TECS, Machine Shop, Task No. 62.

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TASK

MS-05 Identifying drill bits

PERFORMANCE OBJECTIVE

Identify types, sizes and nomenclatures of drill bits.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Four parts of a twist drill bit
b. Types of shanks
c. Purpose of flutes
d. Sizes of twist drills
e. Checking a drill for correct size
f. Using an oil hole drill
g. Lip angle
h. Purpose of tang
i. RPM, FPM

Provide Demonstration On:

Checking a drill for correct size for a given job

Provide Practical Application On:

Check a drill for correct size for a given job.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

Student Manuals:

Ohio, Machine Trades I, Drilling Machine Work Assignment Sheet #5

Tools and Equipment:

a. Twist drill bits
b. Drill gage
c. Cleveland Twist Drill Company, Use and Care of the Twist and Drill

CLASSROOM HOURS

1

EVALUATION (MS-05)

Given specifications for a job, a drill gage and a selection of twist drill bits, the student will be able to select the correct size twist drill for the job.

TASK

MS-06 Identifying cutting feeds and speeds

PERFORMANCE OBJECTIVE

Identify drill feeds and speeds.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types of steel used for twist drills
b. Identifying the high speed drill
c. Setting the speed on a high speed drill four times cutting speed - drill diameter
d. The feed of a drill
e. FPM
f. RPM

Provide Demonstration On:

a. Figuring the cutting speed of a given drill
b. Figuring speed

Provide Practical Application On:

a. Figure the cutting speed of a given drill.
b. Figure speed.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

Student Manuals:

a. Georgia, Metal Fabrication Cluster, PLACE Package Title No. DP-2
b. Ohio, Machine Trades I, Drilling Machine Work Assignment Sheet #6

Tools and Equipment:

a. Drill bits
b. Drilling machine
c. Assigned job

(Continued on back)

CLASSROOM HOURS

2

EVALUATION

a. Given all appropriate tools, supplies and equipment, the student will accurately calculate the feed (in FPM) and speed (in RPM) of a H. S. twist drill for a specific job.

b. V'TECS, Machine Shop, Task No. 64.

c. Georgia, Metal Fabrication Cluster, Teachers Edition.

INSTRUCTIONAL MATERIALS:

Tools and Equipment:

d. Cleveland Twist Drill Company, Use and Care of the Twist Drill

TASK

MS-07 Identifying principles of straight drilling

PERFORMANCE OBJECTIVE

Identify principles and procedures of straight drilling on the drilling machine.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Drilling
b. Pilot of bad hole
c. Scribing a circle in the workpiece
d. Calculating and setting speed and feeds
e. Feeding by hand
f. Chipped tips
g. Drawing or pulling a hole
h. Drilling brass

Provide Demonstration On:

Using the drilling machine to perform straight drilling

Provide Practical Application On:

Drill straight through an assigned workpiece.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

A/Vs:

a. Bergwall, filmstrip #505-5, "Bench Metalwork"
b. Prentice-Hall, filmstrip #XF929, "Machine Shop: Drill Press"

Student Manuals:

a. Georgia, *Metal Fabrication Cluster*, PLACE Package Title No. EP-3
b. Ohio, *Machine Trades I*, Drilling Machine Work Assignment Sheet #7

Tools and Equipment:

a. Drill press
b. Twist drill bits
c. Assigned workpiece

CLASSROOM HOURS

2

EVALUATION (MS-07)

a. Given an assigned workpiece, the student will accurately secure the piece on the drill press, select a drill bit, calculate feed and speed and drill straight through the piece observing all safety precautions.

b. V'TECS, Machine Shop, Task No. 56.

c. Georgia, Metal Fabrication Cluster, Teachers Edition.

TASK

MS-08 Identifying and using coolants and cutting compounds

PERFORMANCE OBJECTIVE

Identify coolants used when drilling or reaming.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Cutting oils
b. Cutting compounds
c. Advantages of using oils and compounds
d. Using turpentine
e. Oil tube drill
f. Reclaiming cutting oils
g. Selecting coolant formula
h. Using a cutting compound
i. Cutting compounds for cast iron
j. Cutting compounds for brass

Provide Demonstration On:

a. Selecting a coolant formula
b. Using a cutting compound

Provide Practical Application On:

a. Select a coolant formula for a given job.
b. Using a cutting compound.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

Student Manuals:

Ohio, Machine Trades I, Drilling Machine Work Assignment Sheet #8

Tools and Equipment:

a. Machinery's Handbook
b. American Machinist's Handbook

CLASSROOM HOURS 2

EVALUATION (MS-08)

Given a specified job, the student will accurately select the appropriate cutting lubricant or compound and drill the stock using the lubricant or compound according to appropriate safe procedures.

TASK

MS-09 Grinding and care of drills

PERFORMANCE OBJECTIVE

Identify and observe proper care and use of drills and be able to correctly grind a drill bit.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Parts of a drill bit
b. Grinding the web of a drill bit (proper web size)
c. Lip angles
d. Lip clearance angle
e. Causes of over-size drilled holes
f. Other drill clearances
g. Measuring the drill bit size

Provide Demonstration On:

Grinding the web of a drill bit to proper web size

Provide Practical Application On:

Grind the web of a drill bit to proper web size.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

A/Vs:

a. Bergwall, filmstrip #505-5, "Bench Metalwork"
b. Prentice-Hall, filmstrip #XF929, "Machine Shop: Drill Press"

Student Manuals:

Ohio, Machine Trades I, Drilling Machine Work Assignment Sheet #9

Tools and Equipment:

a. Drill bits
b. Emery wheel
c. Twist drill gage
d. Machinery's Handbook
e. Handbook for Drillers

CLASSROOM HOURS

2

EVALUATION (MS-09)

a. Given a drill bit and an emery wheel, the student will accurately grind the web of the bit to proper size and gage the size correctly.

b. V'TECS, Machine Shop, Task No. 59.

TASK

MS-10 Identifying and using twist drill gages

PERFORMANCE OBJECTIVE

Identify and use gages used in drill grinding.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Twist drill gage
b. Drill point gage
c. Universal drill grinding gage
d. Reading the twist drill gage
e. Reading the drill point gage

Provide Demonstration On:

a. Using the twist drill gage
b. Using the drill point gage

Provide Practical Application On:

a. Use the twist drill gage and check a twist drill for size.
b. Use the drill point gage to check the angle of the point.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

A/Vs:

a. Bergwall, filmstrip #505-5, "Bench Metalwork"
b. Prentice-Hall, filmstrip #XF919, "Machine Shop: Drill Press"

Student Manuals:

Ohio, Machine Trades I, Drilling Machine Work Assignment Sheet #10

Tools and Equipment:

a. Twist drill gage
b. Drill point gage
c. Twist drill

CLASSROOM HOURS

2

EVALUATION (MS-10)

Given a twist drill gage and a drill point gage, the student will accurately measure several drills for point angle and size.

TASK

MS-11 Identifying and using drill grinding machines

PERFORMANCE OBJECTIVE

Identify and be able to use a drill grinding machine.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Drill grinding machines
   1. Types
   2. Applications
b. Hand grinding
c. Advantages of machine grinding
d. Adapting a regular pedestal grinder
e. Safety

Provide Demonstration On:

Using the drill grinder to correctly grind a drill.

Provide Practical Application On:

Grind a drill on the drill grinder to proper size and point angle.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

Student Manuals:

Ohio, Machine Trades I, Drilling Machine Work Assignment Sheet #11

Tools and Equipment:

a. Drill grinding machine
b. Drill gage
c. Drill point gage
d. Twist drills
e. Safety glasses

CLASSROOM HOURS

1

EVALUATION (MS-11)

a. Given a drill grinding machine, drill gage, point gage and twist drill, the student will accurately grind the drill bit to proper size and point angle.

b. V'TECS, Machine Shop, Task No. 59.

TASK

MS-12 Identifying machine reamers

PERFORMANCE OBJECTIVE

Identify sizes, types, nomenclature, specifications, selection and storage of machine reamers.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types of machine reamers
b. Purpose of a taper reamer
c. Expansion reamer
d. Shell reamer
e. Rose reamer (parts of)
f. Carbide tipped reamers
g. Spiral fluted reamer
h. Method of holding taper shank reamer
i. Method of holding straight shank reamer
j. Storage of reamers
k. Safety

Provide Demonstration On:

Selection of a reamer for a job

Provide Practical Application On:

Select a reamer for a specific job.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

A/Vs:

a. Bergwall, filmstrip #505-5, "Bench Metalwork"
b. Prentice-Hall, filmstrip #XF929, "Machine Shop: Drill Press"

Student Manuals:

Ohio, Machine Trades I, Drilling Machine Work Assignment Sheet #12

Tools and Equipment:

a. Various types of reamers
b. Cleveland Twist Drill Company, Use and Care of Reamers

CLASSROOM HOURS

2

EVALUATION (MS-12)

a. Given specifications for a job, the student will accurately select the best reamer for jobs specified by the instructor.

b. V'TECS, Machine Shop, Task No. 58.

TASK

MS-13 Machine reaming

PERFORMANCE OBJECTIVE

Demonstrate an understanding of machine reaming.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Figuring reaming feed and speed
b. Using cutting oils and compounds for reaming
c. Purpose of reaming
d. Classifying reamers
e. Hand reaming vs. machine reaming
f. Reamer safety

Provide Demonstration On:

a. Calculating reaming feed and speed for a specific job
b. Reaming procedure

Provide Practical Application On:

a. Calculate feed and speed for a reaming job.
b. Use a reamer to ream four 7/8" holes.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

A/VS:

a. Bergwall, filmstrip #505-5, "Bench Metalwork"
b. Prentice-Hall, filmstrip #XF929, "Machine Shop: Drill Press"

Student Manuals:

Ohio, *Machine Trades I*, Drilling Machine Work Assignment Sheet #13

Tools and Equipment:

a. Drilling machine
b. Reamers
c. Safety glasses
d. *Machinery's Handbook*

(Continued on back)

CLASSROOM HOURS

1

EVALUATION (MS-13)

a. Given a reaming job, the student will be able to select the appropriate reamer, calculate speed and feed and accurately ream four 7/8 inch holes which are in accordance with instructor's specifications.

b. V'TECS, Machine Shop, Task No. 58.

INSTRUCTIONAL MATERIALS

Tools and Equipment:

e. American Machinist's Handbook
f. Cleveland Twist Drill Company, Use and Care of Reamers

TASK

MS-14 Identifying principles of boring and counterboring

PERFORMANCE OBJECTIVE

Identify procedures for boring and counterboring.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Difference between boring and counterboring
b. Boring vs reaming
c. Procedure for producing a straight and accurate hole
d. Adjustable single-point boring tool
e. Types of counterbores
f. Parts of the counterbore
g. Purpose of the guide or pilot on the counterbore
h. Removable blade counterbore vs solid counterbore
i. Safety

Provide Demonstration On:

a. Procedure for producing a straight and accurate hole
b. Boring a hole
c. Counterboring a hole

Provide Practical Application On:

a. Bore a hole.
b. Counterbore a hole.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

A/VS:

Prentice-Hall, filmstrip #XF929, "Machine Shop: Drill Press"

Student Manuals:

Ohio, Machine Trades I, Drilling Machine Work Assignment Sheet #14

Tools and Equipment:

a. Machinery's Handbook
b. American Machinist's Handbook
c. Drilling machine
d. Bore
e. Counterbore
f. Safety glasses

CLASSROOM HOURS 2

EVALUATION (MS-14)

a. Given appropriate tools, supplies and equipment, the student will be able to bore and counterbore holes which are straight and accurate. The student must follow all safety practices.

b. V'TECS, Machine Shop, Task No. 53.

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TASK

MS-15 Spot facing

PERFORMANCE OBJECTIVE

Identify procedures and be able to use the drill press in spot facing operations.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Spot facing (purpose)
b. Spot facing tool
c. Spot facing vs counterboring
d. Spot facing cast iron
e. Spot facing speeds/feeds
f. Safety

Provide Demonstration On:

Procedure for spot facing

Provide Practical Application On:

Spot face a piece of material which has been drilled according to given specifications.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

A/VS:

Prentice-Hall, filmstrip #XF929, "Machine Shop: Drill Press"

Student Manuals:

Ohio, Machine Trades I, Drilling Machine Work Assignment Sheet #15

Tools and Equipment:

a. Drilling machine
b. Spot facing tool
c. Pre-drilled metal stock
d. Safety glasses

CLASSROOM HOURS 2

EVALUATION (MS-15)

a. Given a drilling machine and all necessary tools and supplies, the student will accurately spot face a predrilled piece of material to given instructor specifications.

b. V'TECS, Machine Shop, Task No. 65.

TASK

MS-16 Countersinking and center drilling

PERFORMANCE OBJECTIVE

Perform countersinking and center drilling operations on the drilling machine.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Counter boxing vs countersinking
b. Purpose of countersinking
c. Countersinking angles
d. Causes of chattering (prevention)
e. Center drilling vs countersinking
f. Angle of center drilling
g. Safety

Provide Demonstration On:

a. Procedure for counter sinking
b. Procedure for center drilling

Provide Practical Application On:

a. Countersink a workpiece
b. Center drill a workpiece.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

A/VS:

Prentice-Hall, filmstrip #XF929 "Machine Shop: Drill Press"

Student Manuals:

Ohio, Machine Trades I, Drilling Machine Work Assignment Sheet #16

Tools and Equipment:

a. Machinery's Handbook
b. Drilling machine
c. Countersinking tool
d. Center drilling tool
e. Safety glasses

CLASSROOM HOURS 4

EVALUATION (MS-16)

a. Given all necessary tools and equipment, the student will be able to accurately countersink a workpiece (pre-drilled) to specifications following all safety practices.

b. Given all necessary tools and equipment, the student will be able to accurately center drill a workpiece (pre-drilled) to specifications following all safety practices.

c. V'TECS, Machine Shop, Task No. 54.

TASK

MS-17 Identifying power cut-off saws

PERFORMANCE OBJECTIVE

Identify power cut-off saws by types, sizes, nomenclature and range of work.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Sizing of a power cut-off
b. Cut of the blade
c. Mounting material in the vise
d. Blade maintenance
e. Safety

Provide Demonstration On:

Determining the size (range) of a power cut-off saw

Provide Practical Application On:

Determine the size of a power cut-off saw and identify its cutting capability and use.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Porter
c. Kibbe

Student Manuals:

Ohio, Machine Trades I, Power Saw Work Assignment Sheet #1

Tools and Equipment:

Power saws, several different types (or pictures)

CLASSROOM HOURS

2

EVALUATION (MS-17)

Given a power cut-off saw, the student will be able to identify the size and type of saw and describe its cutting action.

TASK

MS-18 Identifying power saw safety

PERFORMANCE OBJECTIVE

Identify safe practices and work habits on the power saw.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Belt and pulley guards
b. Loose clothing
c. Jewelry
d. Hair
e. Cutting short pieces
f. Cutting in an old cut with a new blade
g. Personal safety gear

Provide Demonstration On:

Safe use of the power saw

Provide Practical Application On:

Name at least six safety hazards when using a power saw.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe

Student Manuals:

Ohio, Machine Trades I, Power Saw Work Assignment Sheet #2

CLASSROOM HOURS 1

EVALUATION (MS-18)

Given a power saw, the student will be able to identify and describe at least six safety hazards or precautions when using the saw.

TASK

MS-19 Identifying and using work holding devices on the power cut-off saw

PERFORMANCE OBJECTIVE

Identify types of work holding devices used on the power cut-off saw.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Positioning flat stock in the vise
b. Types and sizes of vises
c. Importance of holding work securely in the vise
d. Cutting more than one piece
e. Angular cutting

Provide Demonstration On:

Positioning workpiece in the vise

Provide Practical Application On:

Position a given workpiece in the vise correctly and identify the type and size of vise.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

Student Manuals:

Ohio, Machine Trades I,
Power Saw Work Assignment
Sheet #3

Tools and Equipment:

a. Power saw
b. Work holding devices

CLASSROOM HOURS 4

EVALUATION (MS-19)

Given a power cut-off saw and an assigned workpiece, the student will be able to correctly position the workpiece in the vise.

TASK

MS-20 Identifying, selecting, mounting and maintaining saw blades

PERFORMANCE OBJECTIVE

Identify, select, mount and maintain saw blades.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Hacksaw blades
b. "All hard" blades
c. "Flexible" blade
d. Saw blade tooth patterns
e. Application of saw blades
f. Blade maintenance

Provide Demonstration On:

Choosing a blade for job

Provide Practical Application On:

Choose the correct type of blade for an assigned job.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

Student Manuals:

Ohio, Machine Trades I, Power Saw Work Assignment Sheet #4

Tools and Equipment:

a. Saw blades
b. Catalogs for saw blades

CLASSROOM HOURS

4

EVALUATION

(MS-20)

Given an assigned job on the power cut-off saw, the student will be able to select an appropriate saw blade for the job.

TASK

MS-21 Identifying speeds, feeds and coolants for power cut-off saws

PERFORMANCE OBJECTIVE

Identify and be able to calculate speeds, feeds and requirements for coolants for the power cut-off saws.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Coolants
b. Cutting speed (strokes per minute)
c. Cutting feed (feed per minute)
d. Operating a saw without coolant
e. Applying coolant

Provide Demonstration On:

Determining feeds, speeds and coolant requirements for a given job

Provide Practical Application On:

Calculate feed, speed and requirement for a coolant for an assigned job on the power cut-off saw and make a specified cut.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe

A/Vs:

Bergwall, filmstrip #505-2, "Bench Metalwork"

Student Manuals:

Ohio, Machine Trades I, Power Saw Work Assignment Sheet #16

Tools and Equipment:

a. Power saw
b. Workpiece
c. Coolant
d. Manufacturer's speed recommendations for saw

CLASSROOM HOURS

2

EVALUATION (MS-21)

a. Given a power cut-off saw, specifications and all necessary tools and materials, the student will be able to calculate the appropriate feed and speed for the job, determine coolant requirements if any and make a specified cut following all safety precautions.

b. V'TECS, Machine Shop, Task No. 145.

TASK

MS-22 Using the power cut-off saw for straight and angular sawing

PERFORMANCE OBJECTIVE

Set up and use the power cut-off saw to perform straight and angular operations.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Leaving extra length when cutting off material
b. Dull blades
c. Straight cuts
d. Angle cuts
e. Sawing pipe or tube
f. When to change blades
g. Safety

Provide Demonstration On:

Cutting straight and angular cuts on the power hacksaw

Provide Practical Application On:

Make an assigned straight or angular cut on the power hacksaw.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe

A/Vs:

Bergwall, filmstrip #505-2, "Bench Metalwork"

Student Manuals:

Ohio, Machine Trades I, Power Saw Work Assignment Sheet #6

Tools and Equipment:

a. Power hacksaw
b. Blades
c. Work stock
d. Safety goggles

CLASSROOM HOURS

4

EVALUATION (MS-22)

a. Given a power hacksaw, specifications, all necessary tools and materials and an assigned workpiece, the student will be able to cut the workpiece according to specified dimensions.

b. V'TECS, Machine Shop, Task No. 144.

TASK

MS-23 Identifying the metal band saw

PERFORMANCE OBJECTIVE

Identify types of metal band saws and ranges of work.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types of metal cutting band saws
b. Types of materials which are out on the band saw
c. Operating the feed
d. Work capacity

Provide Demonstration On:

Operating the feed on the metal band saw

Provide Practical Application On:

Identify the metal band saw, be able to operate the feed and set it for an assigned job.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part II
b. Kibbe

A/Vs:

Bergwall, filmstrip #505-2, "Bench Metalwork"

Student Manuals:

Ohio, Machine Trades I, Power Saw Work Assignment Sheet #7

Tools and Equipment:

a. Metal band saw
b. The Do All Company, Band Tool Manual

CLASSROOM HOURS 2

EVALUATION (MS-23)

Given a metal band saw, the student will be able to identify the saw in the lab and set the feed on the saw for an assigned job.

TASK

MS-24 Identifying coolants and lubricating agents for band saws

PERFORMANCE OBJECTIVE

Identify coolants and lubricating agents used for band saw work.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Purpose of coolants and lubricants
b. Applying lubricant
c. Materials which require a lubricant
d. Diamond tooth band tools

Provide Demonstration On:

Choosing a coolant for a given job

Provide Practical Application On:

Choose an appropriate coolant for an assigned job on the power band saw.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part II
b. Kibbe

A/Vs:

Bergwall, filmstrip #505-2, "Metal Benchwork"

Student Manuals:

Ohio, Machine Trades I, Power Saw Work Assignment Sheet #8

Tools and Equipment:

a. Power band saw
b. Coolants
c. The Do All Company, Band Tool Manual

CLASSROOM HOURS 2

EVALUATION (MS-24)

Given an assigned job on the power band saw, the student will be able to choose an appropriate lubricant for the job, if required, and describe the method of lubricant application correctly.

TASK

MS-25 Choosing saw blades for the metal band saw

PERFORMANCE OBJECTIVE

Choose saw blades for the metal band saw.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Band saw blade types
b. Choosing a blade type for a job
c. Using precision blades
d. Using friction sawing blades
e. Using buttress blades
f. Claw-tooth blade
g. Knife edge blade
h. Spiral edge blade

Provide Demonstration On:

Choosing a band saw blade for an assigned job

Provide Practical Application On:

Choose a band saw blade for an assigned job.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part II
b. Kibbe

A/Vs:

Bergwall, filmstrip #505-2, "Bench Metalwork"

Student Manuals:

Ohio: Machine Trades I, Power Saw Work Assignment Sheet #9

Tools and Equipment:

a. Band saw blades, several types
b. The Do All Company, Band Tool Manual

CLASSROOM HOURS

2

EVALUATION (MS-25)

a. Given an assigned job on the metal band saw, the student will be able to choose the correct type of metal band saw blade for the job.

b. V'TECS, Machine Shop, Task No. 146.

TASK

MS-26 Calculating feeds and speeds for metal band saw

PERFORMANCE OBJECTIVE

Calculating feeds and speeds for jobs on the metal band saw.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Speed ranges of a metal
b. Applying pressure to the work
c. Results of incorrect speeds
d. Method of feeding
e. Adjusting feed rate
f. Adjusting the speed

Provide Demonstration On:

Adjusting the feed and speed of the power band saw

Provide Practical Application On:

Adjust the feed and speed of the power band saw for an assigned job.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part II
b. Kibbe

A/Vs:

Bergwall, filmstrip #505-2, "Bench Metalwork"

Student Manuals:

Ohio: Machine Trades I, Power Saw Work Assignment Sheet #10

Tools and Equipment:

a. Power band saw
b. The Do All Company, Band Tool Manual

CLASSROOM HOURS 4

EVALUATION (MS-26)

a. Given an assigned job on the power band saw, the student will be able to set the correct feed and speed for the job.

b. V'TECS, Machine Shop, Task No. 145.

TASK

MS-27 Identifying lathe safety

PERFORMANCE OBJECTIVE

Identify safe practices and precautions for engine lathe work.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Importance of safety
b. Hazards
    1. Long sleeves
    2. Rings, watches, etc.
    3. Files without handles
    4. Pinch points
    5. High temperature components
    6. Sharp edges
c. Safety practices
d. Personal protection gear
e. Housekeeping

Provide Demonstration On:

Proper filing technique in the lathe

Provide Practical Application On:

List six hazards in lathe operation and how to avoid them.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Porter
c. Kibbe

A/Vs:

Bergwall, filmstrip #514, "Metal Shop Safety"

Student Manuals:

a. Georgia, Metal Fabrication Cluster, PLACE Package Title No. EL-2
b. Ohio, Machine Trades I, Engine Lathe Work Assignment Sheet #1

CLASSROOM HOURS	2

EVALUATION (MS-27)

a. Given an overview of lathe safety practices, the student will be able to list at least six safety hazards in lathe operation and the safety precautions associated with them.

b. Georgia, Metal Fabrication Cluster, Teachers Edition.

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TASK

MS-28 Identifying lathes

PERFORMANCE OBJECTIVE

Identify engine lathe types and sizes.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Brief history of automation in industry
b. The lathe
    1. Determining engine size
    2. Three basic types
    3. Purpose of various sizes
    4. Purpose of headstock
    5. Standard vs quick change geared
    6. "Live center" vs "dead center"
    7. Operations which can be performed on a lathe
    8. Gages and how they are used

Provide Practical Application On:

a. Identify and describe the purpose of the parts of a lathe on a diagram.
b. List the operations which can be performed on a lathe.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

A/Vs:

a. Bergwall, filmstrip #501-1, "The Lathe Explained"
b. Prentice-Hall, filmstrip #XF928, "Machine Shop: Engine Lathe"

Student Manuals:

a. Georgia, *Metal Fabrication Cluster*, PLACE Package Title No. #L-1, EL-3
b. Ohio, *Machine Trades I*, Engine Lathe Work Assignment Sheet #1

Tools and Equipment:

Diagram of a lathe

CLASSROOM HOURS

2

EVALUATION (MS-28)

a. Given a diagram of a lathe, the student will be able to identify each part or control, describe its use accurately and list at least five operations which can be performed on a lathe.

b. Georgia, Metal Fabrication Cluster, Teachers Edition.

TASK

MS-29 Identifying work holding devices

PERFORMANCE OBJECTIVE

Identify work holding devices as used on a lathe.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Lathe spindle nose
b. Chucks
c. Drive plates
d. Faceplates
e. Collets
f. Centering accuracy of various chucks

Provide Practical Application On:

Identify several types of chucks in the lab.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

A/Vs:

a. Bergwall, filmstrip #501-2, "The Lathe Explained"
b. Prentice-Hall, filmstrip #XF928, "Machine Shop: Engine Lathe"

Student Manuals:

a. Georgia, Metal Fabrication Cluster, PLACE Package Title No. BLO-1, OLO-12
b. Ohio, Machine Trades I, Engine Lathe Work Assignment Sheet #3

Tools and Equipment:

Several types of chucks

CLASSROOM HOURS

2

EVALUATION (MS-29)

a. Given a selection of lathe work holding devices, the student will be able to identify each type of chuck and describe its relative accuracy.

b. V'TECS, Machine Shop, Task No. 110.

c. Georgia, Metal Fabrication Cluster, Teachers Edition.

TASK

MS-30 Identifying cutting tools

PERFORMANCE OBJECTIVE

Identify cutting tools and tool holding devices on the lathe.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Cutting tools
b. Geometric form of lathe tools
c. Tool grinding
d. Tool holder
e. Tool holder with back rake
f. Cutting angles
g. Chip safety (chip breakers)
h. Heat hazards

Provide Demonstration On:

a. Grinding a lathe tool
b. Choosing a tool

Provide Practical Application On:

Choose a tool for a specified job and grind the tool to proper shape and dimensions.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

A/Vs:

a. Bergwall, filmstrip #501-3, "The Lathe Explained"
b. Prentice-Hall, filmstrip #XF928, "Machine Shop: Engine Lathe"

Student Manuals

a. Georgia, *Metal Fabrication Cluster*, PLACE Package Title No. GLT-1 through GLT-4
b. Ohio, *Machine Trades I*, Engine Lathe Work Assignment Sheets #4 and #5
c. *Machine Shop Training Course*, Vol. I

Tools and Equipment:

a. Grinding wheel
(Continued on back)

CLASSROOM HOURS 2

EVALUATION (MS-30)

a. Given specifications for a lathe operation, the student will be able to correctly choose the appropriate tool for the job and follow correct procedures in grinding the tool to proper shape for use on the lathe.

b. Georgia, Metal Fabrication Cluster, Teachers Edition.

INSTRUCTIONAL MATERIALS

Tools and Equipment:

b. Lathe tools
c. South Bend Lathe Works,
   How to Run a Lathe

TASK

MS-31 Identifying measuring tools

PERFORMANCE OBJECTIVE

Identify measuring tools used in engine lathe work.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Calipers
b. Micrometer
c. Snap and plug gages
d. Steel rules
e. Depth gages
f. Safety

Provide Demonstration On:

Using the following to make measurements
a. Calipers
b. Micrometer
c. Snap and plug gages
d. Steel gages
e. Depth gages

Provide Practical Application On:

Use the following instruments to make assigned measurements.
a. Calipers
b. Micrometer
c. Snap and plug gages
d. Steel rules
e. Depth gage

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Porter
c. Kibbe

A/Vs:

Bergwall, filmstrip #503, "Measuring Tools"

Student Manuals:

a. Georgia, Metal Fabrication Cluster, PLACE Package Title No. M-1 through M-2
b. Ohio, Machine Trades I, Engine Lathe Work Assignment Sheet #6
c. Machine Shop Training Course, Vol. I

Tools and Equipment:

a. Calipers (inside and outside)

(Continued on back)

CLASSROOM HOURS 2

EVALUATION (MS-31)

a. Given assigned objects to measure, the student will be able to follow correct procedure and use the following tools to make measurements.
    1. Calipers
    2. Micrometer
    3. Snap and plug gages
    4. Steel ruler
    5. Depth gages

b. Georgia, Metal Fabrication Cluster, Teachers Edition.

INSTRUCTIONAL MATERIALS

Tools and Equipment:

b. Micrometer
c. Snap and plug gages
d. Steel rules
e. Depth gage
f. South Bend Lathe Works, How to Run a Lathe
g. U.S. Navy, Tools and Their Uses

TASK

MS-32 Identifying lathe attachments

PERFORMANCE OBJECTIVE

Identify attachments used on an engine lathe and describe their uses.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Center rest
b. Turning long, slim work
c. Follower rest
d. Taper attachment

Provide Demonstration On:

Mounting the following on a lathe
a. Center test
b. Follower rest
c. Taper attachment

Provide Practical Application On:

Identify various types of lathe attachments in the lab and mount the following on the lathe.
a. Center rest
b. Follower rest
c. Taper attachment

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

A/Vs:

a. Bergwall, filmstrip #501-3, "The Lathe Explained"
b. Prentice-Hall, filmstrip #XF928, "Machine Shop: Engine Lathe"

Student Manuals:

Ohio, *Machine Trades I, Engine Lathe Work*, Assignment Sheet #7

Tools and Equipment:

a. Center rest
b. Follower rest
c. Taper attachment
d. Lathe
e. Hand tools
f. South Bend Lathe Works, *How to Run a Lathe*

CLASSROOM HOURS 2

EVALUATION (MS-32)

Given appropriate tools, supplies and equipment, the student will be able to mount and describe the use of the lathe with the following attachments.

a. Center rest
b. Follower rest
c. Taper attachment

TASK

MS-33 Calculating cutting feeds and speeds on the lathe

PERFORMANCE OBJECTIVE

Calculate cutting feeds and speeds on the lathe.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Cutting speed formula
b. Feed
c. Cutting speed
d. Formula for circumference of a circle
e. Variance in cutting speed
f. Figuring feed

Provide Demonstration On:

a. Figuring cutting speed
b. Figuring feed

Provide Practical Application On:

Figure cutting speed and feed for a specified job.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

A/Vs:

a. Bergwall, filmstrip #501-2, "The Lathe Explained"
b. Prentice-Hall, filmstrip #XF928, "Machine Shop: Engine Lathe"

Student Manuals:

a. Ohio, Machine Trades I, Engine Lathe Work Assignment Sheet #8
b. Machine Shop Training Course, Vol. I

Tools and Equipment:

a. Lathe
b. Cutting tool
c. Workpiece
d. South Bend Lathe Works, How to Run a Lathe

CLASSROOM HOURS

3

EVALUATION (MS-33)

Given specifications for a job and all necessary tools, supplies and equipment, the student will be able to calculate the necessary feed and speed required to complete the job.

TASK

MS-34 Determining RPM

PERFORMANCE OBJECTIVE

Calculate RPM for a known cutting speed, rim speed or surface speed on an engine lathe.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Formula for figuring RPM of a lathe
b. Calculating the formula given cutting speed, rim speed or surface speed

Provide Demonstration On:

Calculating lathe RPM given cutting speed, rim speed or surface speed

Provide Practical Application On:

Work lathe RPM problems.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

A/Vs:

a. Bergwall, filmstrip #501-2, "The Lathe Explained"
b. Prentice-Hall, filmstrip #XF928 "Machine Shop: Engine Lathe"

Student Manuals:

a. Ohio, Machine Trades I, Engine Lathe Work Assignment Sheet #9
b. Machine Shop Training Course, Vol. I

Tools and Equipment:

South Bend Lathe Works, How to Run a Lathe

CLASSROOM HOURS

2

EVALUATION (MS-34)

a. Given a known cutting speed, rim speed or surface speed, the student will be able to accurately calculate lathe RPM.

b. V'TECS, Machine Shop, Task No. 109.

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TASK

MS-35 Centering stock

PERFORMANCE OBJECTIVE

Identify principles of centering stock on the engine lathe.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Reason for various sizes of combination center drills
b. Methods of locating center holes
c. Standard angle for center holes
d. Square-facing the work
e. Testing the work for trueness
f. Finding centers of irregularly shaped work

Provide Demonstration On:

a. Centering a piece of work on a lathe
b. Testing for trueness

Provide Practical Application On:

Square and center a piece of work on a lathe.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

A/Vs:

a. Bergwall, filmstrip #501-2, "The Lathe Explained"
b. Prentice-Hall, filmstrip #XF928, "Machine Shop: Engine Lathe"

Student Manuals:

a. Georgia, Metal Fabrication Cluster, PLACE Package Title No. BLO-5
b. Ohio, Machine Trades I, Engine Lathe Work Assignment Sheet #10
c. Machine Shop Training Course, Vol. I

Tools and Equipment:

a. Lathe
(Continued on back)

CLASSROOM HOURS

2

EVALUATION (MS-35)

a. Given a specified job and all necessary tools and equipment, the student will be able to center the stock correctly on the engine lathe and check for accuracy of alignment.

b. V'TECS, Machine Shop, Task Nos. 85 and 86.

INSTRUCTIONAL MATERIALS

Tools and Equipment:

b. Workpiece
c. Test bar and dial indicators
d. Centering tools
e. South Bend Lathe Works, How to Run a Lathe

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TASK

MS-36 Identifying principles of facing

PERFORMANCE OBJECTIVE

Identify principles of and facing on an engine lathe.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Facing
b. Leaving work longer than finished size
c. Right-cut facing tool
d. Half-center
e. Measuring
    1. Steel rule
    2. Vernier caliper
    3. Large micrometer

Provide Demonstration On:

Facing a workpiece

Provide Practical Application On:

Face a workpiece to specified dimensions.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

A/Vs:

a. Bergwall, filmstrip #501-4, "The Lathe Explained"
b. Prentice-Hall, filmstrip #XF928, "Machine Shop: Engine Lathe"

Student Manuals:

a. Georgia, Metal Fabrication Cluster, PLACE Package Title No. BLO-4
b. Ohio, Machine Trades I, Engine Lathe Work Assignment Sheet #11
c. Machine Shop Training Course, Vol. 1

Tools and Equipment:

a. Lathe
b. Cutting tool

(Continued on back)

CLASSROOM HOURS

2

EVALUATION

a. Given all necessary tools, equipment and specifications, the student will be able to face a workpiece to specifications and observe all safety practices and procedures.

b. V'TECS, Machine Shop, Task No. 98.

c. Georgia, Metal Fabrication Cluster, Teachers Edition.

INSTRUCTIONAL MATERIALS

Tools and Equipment:

c. Workpiece
d. Steel rules
e. South Bend Lathe Works,
   How to Run a Lathe

TASK

MS-37 Identifying principles of straight turning and turning to shoulders

PERFORMANCE OBJECTIVE

Identify principles of straight turning and turning to shoulders.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Rough turning
  1. Tolerance
  2. Setting the compound
  3. Tool-holder
  4. Safety
  5. Making a trial cut to true up the piece
  6. Lubricating the tail center
b. Finish turning
  1. Selection of cutting
  2. Using the micrometer
  3. Safety

(Continued on back)

Provide Demonstration On:

a. Rough turning a piece
b. Finish turning
c. Turning a shoulder

Provide Practical Application On:

a. Perform straight turning on a piece.
b. Perform shoulder turning on a piece.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

A/Vs:

a. Bergwall, filmstrip #501-4, "The Lathe Explained"
b. Prentice-Hall, filmstrip #XF928, "Machine Shop: Engine Lathe"

Student Manuals:

a. Georgia, Metal Fabrication Cluster, PLACE Package Title No. BLO-2, BLO-3
b. Ohio, Machine Trades I, Engine Lathe Work Assignment Sheet #12
c. Machine Shop Training Course, Vol. I

Tools and Equipment:

a. Lathe

(Continued on back)

CLASSROOM HOURS

4

EVALUATION (MS-37)

a. Given appropriate tools, supplies and materials, the student will be able to perform turning operations on the lathe. The student will perform turning and turning to shoulder.

b. V'TECS, Machine Shop, Task No. 100.

c. Georgia, Metal Fabrication Cluster, PLACE Package Title BLO-2, BLO-3.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

c. Turning to shoulder
    1. Machining a piece to several different diameters
    2. Square shoulder
    3. Angular shoulder
    4. Filleted shoulder
    5. Undercut shoulder
    6. Using the fillet or radius gage

INSTRUCTIONAL MATERIALS

Tools and Equipment:

b. Cutting tools
c. Safety goggles
d. Micrometer
e. Fillet or radius gage

TASK

MS-38 Identifying chucks

PERFORMANCE OBJECTIVE

Identify types, sizes, nomenclature, specifications, selection and storage of chucks.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Purpose of a chuck
b. Common types of chucks
    1. 3-jaw universal
    2. 4-jaw independent
    3. Jacobs chuck
    4. Draw-in collet chuck
c. Selecting chuck jaws
d. Mounting and removing chucks
e. Safety
f. Storage of chucks

Provide Demonstration On:

a. Selecting chuck jaws and installing them
b. Mounting and removing chucks

Provide Practical Application On:

Select chuck jaws and install them and correctly mount and remove chucks from a lathe.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

A/Vs:

a. Bergwall, filmstrip #501-4, "The Lathe Explained"
b. Prentice-Hall, filmstrip #XF928, "Machine Shop: Engine Lathe"

Student Manuals:

a. Georgia, Metal Fabrication Cluster, PLACE Package Title No. BLO-1
b. Ohio, Machine Trades I, Engine Lathe Work Assignment Sheet #13
c. Machine Shop Training Course, Vol. I

Tools and Equipment:

a. Lathe

(Continued on back)

CLASSROOM HOURS 2

EVALUATION

a. Given a specified job, the student will be able to select a chuck, mount the jaws, correctly mount and remove the chuck on the lathe and observe all safety precautions.

b. Georgia, Metal Fabrication Cluster, Teachers Edition.

INSTRUCTIONAL MATERIALS

Tools and Equipment:

b. Handtools
c. Chucks and jaws
d. Wooden board
e. South Bend Lathe Works,
How to Run a Lathe

TASK

MS-39 Form turning

PERFORMANCE OBJECTIVE

Perform the operation of form turning on the lathe.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Free-hand form turning
b. Eye-hand coordination
c. Form turning with a tool ground to the desired shape
d. Operating controls for form turning
e. Tape operated machines
f. Spring tool
g. Setting the cutting speed

Provide Demonstration On:

Form turning on a lathe

Provide Practical Application On:

Form turn a specified shape on a lathe.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe

A/Vs:

a. Bergwall, filmstrip #501, "The Lathe Explained"
b. Prentice-Hall, filmstrip #XF928, "Machine Shop: Engine Lathe"

Student Manuals:

a. Ohio, *Machine Trades I*, Engine Lathe Work Assignment Sheet #14
b. *Machine Shop Training* Course, Vol. I

Tools and Equipment:

a. Lathe
b. Workpiece
c. Hand tools
d. Cutting tools

CLASSROOM HOURS

6

EVALUATION (MS-39)

Given appropriate tools, supplies, equipment and specifications, the student will be able to form turn a workpiece to a specified shape.

TASK

MS-40 Identifying faceplate work.

PERFORMANCE OBJECTIVE

Identify principles of faceplate work and accessories used.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Accessories used for faceplate work
   1. End measuring rod
   2. Square head bolt
   3. Faceplate stud
   4. U-clamp
   5. Parallel
   6. Parallel strip
   7. Angle plate
   8. Stop block
b. Classes of work which are machined on a face plate
c. Trueing-up work on a faceplate
d. Counterbalancing
e. Clamping the work

Provide Demonstration On:

Mounting a workpiece on a faceplate using T-bolts and strap clamps

Provide Practical Application On:

Mount a workpiece on a faceplate using T-bolts and strap clamps.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

A/Vs:

a. Bergwall, filmstrip #501-4, "The Lathe Explained"
b. Prentice-Hall, filmstrip #XF928, "Machine Shop: Engine Lathe"

Student Manuals:

a. Georgia, Metal Fabrication Cluster, PLACE Package Title No. OLO-10, OLO-11
b. Ohio, Machine Trades I, Engine Lathe Work Assignment Sheet #16
c. Machine Shop Training Course, Vol. I

Tools and Equipment:

a. Lathe with faceplate

(Continued on back)

CLASSROOM HOURS 3

EVALUATION (MS-40)

a. Given all necessary tools, supplies and equipment, the student will be able to mount a workpiece on a faceplate using T-bolts and strap clamps so that the work is held straight and true.

b. V'TECS, Machine Shop, Task No. 98.

c. Georgia, Metal Fabrication Cluster, Teachers Edition.

INSTRUCTIONAL MATERIALS

Tools and Equipment:

b. T-bolts
c. Strap clamps
d. Wrenches
e. South Bend Lathe Works,
How to Run a Lathe

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TASK

MS-41 Using draw-in collets

PERFORMANCE OBJECTIVE

Identify principles of and be able to use draw-in collets on the engine lathe.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Advantages of draw-in collets
b. How collets are held in a lathe
c. Classes of work held in collets
d. Advantages of hollow draw bar
e. Securing the collet in the collet sleeve
f. Collet safety

Provide Demonstration On:

Installing collets on the lathe

Provide Practical Application On:

Install a collet on a lathe.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

A/Vs:

a. Bergwall, filmstrip #501-3, "The Lathe Explained"
b. Prentice-Hall, filmstrip #XF928, "Machine Shop: Engine Lathe"

Student Manuals:

a. Georgia, Metal Fabrication Cluster, PLACE Package Title No. OLO-12
b. Ohio, Machine Trades I, Engine Lathe Work Assignment Sheet #17
c. Machine Shop Training Course, Vol. I

Tools and Equipment:

a. Lathe
(Continued on back)

CLASSROOM HOURS 4

EVALUATION (MS-41)

a. Given appropriate tools and equipment, the student will be able to install a collet chuck on a lathe following correct procedure and all safety precautions.

b. Georgia, Metal Fabrication Cluster, Teachers Edition.

INSTRUCTIONAL MATERIALS

Tools and Equipment:

b. Collet chuck
c. Wrenches
d. South Bend Lathe Works, How to Run a Lathe

TASK

[illegible]-42 Identifying principles of drilling

PERFORMANCE OBJECTIVE

Identify and apply principles of drilling on an engine lathe.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Mounting work for drilling
b. Pilot drilling
c. Lathe dog
d. Alignment
e. Necessity for reaming
f. Safety

Provide Demonstration On:

a. Mounting a straight shank drill in a drill chuck
b. Mounting a workpiece
c. Drilling a workpiece

Provide Practical Application On:

Mount a drill in a chuck, mount assigned work and drill to given specifications.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

A/Vs:

Bergwall, filmstrip #505-5, "Bench Metalwork"

Student Manuals:

a. Georgia, Metal Fabrication Cluster, PLACE Package Title No. OLO-1
b. Ohio, Machine Trades I, Engine Lathe Work Assignment Sheet #18
c. Machine Shop Training Course, Vol. I

Tools and Equipment:

a. Lathe

(Continued on back)

CLASSROOM HOURS

2

EVALUATION (MS-42)

a. Given all necessary tools, equipment and specifications, the student will be able to drill a workpiece to specified dimensions following all standard safety practices.

b. V'TECS, Machine Shop, Task No. 97.

c. Georgia, Metal Fabrication Cluster, Teachers Edition.

INSTRUCTIONAL MATERIALS:

Tools and Equipment:

b. Drill
c. Drill chuck
d. Collet or faceplate
e. Tools
f. Lathe dog (for larger drills
g. Safety goggles
h. South Bend Lathe Works, How to Run a Lathe

TASK

MS-43 Identifying machine reamers

PERFORMANCE OBJECTIVE

Identify reamers used on the engine lathe.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types of reamers
b. Adjustable reamer
c. Shell reamer
d. Flutes of the reamer
e. Advantages of spiral flutes
f. Chucking reamer
g. Parts of a reamer

Provide Demonstration On:

a. Identifying parts of a reamer
b. Identifying types of reamers

Provide Practical Application On:

a. Identify the parts of a reamer (six).
b. Identify types of reamers.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

A/Vs:

Bergwall, filmstrip #505-5, "Bench Metalwork"

Student Manuals:

a. Ohio, Machine Trades I, Engine Lathe Work Assignment Sheet #19
b. Machine Shop Training Course, Vol. I

Tools and Equipment:

a. Reamer
b. Cleveland Twist Drill Company, Use and Care of Reamers

CLASSROOM HOURS

2

EVALUATION (MS-43)

Given a selection of reamers, the student will be able to correctly identify the type of reamer and correctly name the six basic parts of a reamer.

TASK

MS-44 Reaming on the engine lathe

PERFORMANCE OBJECTIVE

Perform reaming operations on the engine lathe.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Purpose of reaming
b. How a reamer is held on the lathe
c. Calculating speeds and feeds for reaming
d. Lubricants for reaming
e. Small machine reamers
f. Alignment
g. Safety

Provide Demonstration On:

a. Mounting a reamer on the lathe
b. Reaming on the lathe

Provide Practical Application On:

Mount a reamer on a lathe and ream a hole in a pre-drilled workpiece to specified dimensions.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

A/Vs:

Bergwall, filmstrip #505-5, "Bench Metalwork"

Student Manuals:

a. Georgia, Metal Fabrication Cluster, PLACE Package Title No. OLO-9
b. Ohio, Machine Trades I, Engine Lathe Work Assignment Sheet #20
c. Machine Shop Training Course, Vol. I

Tools and Equipment:

a. Reamers

(Continued on back)

CLASSROOM HOURS

4

EVALUATION (MS-44)

a. Given a lathe, reamers, pre-drilled workpiece and specifications, the student will mount a reamer on the lathe, correctly ream the drilled holes on the workpiece to specified dimensions and follow all safety precautions.

b. V'TECS, Machine Shop, Task No. 104.

c. Georgia, Metal Fabrication Cluster, Teachers Edition.

INSTRUCTIONAL MATERIALS

Tools and Equipment:

b. Lathe
c. Workpiece
d. Tools
e. Safety goggles
f. Cleveland Twist Drill Company, Use and Care of Reamers

TASK

MS-45 Boring on the engine lathe

PERFORMANCE OBJECTIVE

Perform boring operations on the engine lathe.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Boring
b. Methods of boring
c. Why a drilled hole must be bored
d. Forged boring tool
e. Boring bar holder
f. Measuring tools
g. Chatter and vibration
h. Through-boring
i. Thread-relief
j. Safety

Provide Demonstration On:

Boring a drilled hole

Provide Practical Application On:

Bore a drilled hole to specifications.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

A/Vs:

a. Bergwall, filmstrip #505-5, "Bench Metalwork"
b. Prentice-Hall, filmstrip #XF928, "Machine Shop: Engine Lathe"

Student Manuals:

a. Georgia, Metal Fabrication Cluster, PLACE Package Title No. OLO-6
b. Ohio, Machine Trades I, Engine Lathe Work Assignment Sheet #21
c. Machine Shop Training Course, Vol. I

Tools and Equipment:

a. Lathe
(Continued on back)

CLASSROOM HOURS

4

EVALUATION

a. Given appropriate tools, supplies and equipment, the student will be able to bore a drilled hole to specified dimensions and observe all safety precautions.

b. V'TECS, Machine Shop, Task No. 87.

c. Georgia, Metal Fabrication Cluster, Teachers Edition.

INSTRUCTIONAL MATERIALS

Tools and Equipment:

b. Drilled workpiece
c. Measuring tools
d. Boring tools
e. Safety goggles

TASK

MS-46 Identifying and using mandrels

PERFORMANCE OBJECTIVE

Identify types of and be able to use mandrels on the engine lathe.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Mandrels (or lathe arbors)
b. Purpose of mandrels
c. Tapered mandrels
d. Lathe dog and set screw
e. Lubrication
f. Expanding mandrels
g. Gang mandrels
h. Stub mandrels
    1. Expanding stub mandrels
    2. Threaded stub mandrels
i. Safety

Provide Demonstration On:

Pressing a mandrel into a workpiece

Provide Practical Application On:

a. Press a mandrel into a workpiece.
b. Identify types of mandrels in the lab.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

A/Vs:

a. Bergwall, filmstrip #505-5, "Bench Metalwork"
b. Prentice-Hall, filmstrip #XF928, "Machine Shop: Engine Lathe"

Student Manuals:

a. Ohio, Machine Trades I, Engine Lathe Work Assignment Sheet #22
b. Machine Shop Training Course, Vol. I

Tools and Equipment:

a. Workpiece
b. Mandrel(s)
c. Tools
d. Safety goggles

CLASSROOM HOURS

2

EVALUATION (MS-46)

Given appropriate tools, supplies and equipment, the student will be able to select and press a mandrel into a workpiece and follow correct procedures and safety precautions.

TASK

MS-47 Knurling on the engine lathe

PERFORMANCE OBJECTIVE

Identify types of tools and be able to perform knurling operations on the engine lathe.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Knurling
b. Knurling patterns
    1. Diamond
    2. Straight
c. Knurling tool holders
    1. Knuckle-joint holder
    2. Revolving head holder
    3. Straddle holder
d. Holding the work
e. Lubrication
f. Cleaning knurls
g. Knurl cutting tool
h. Safety

Provide Demonstration On:

Making diamond pattern knurls on a rough piece of work

Provide Practical Application On:

Mount work on a lathe, mount on knurling tool and make a diamond pattern knurl on the work to specifications.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

A/Vs:

Prentice-Hall, filmstrip #XF928, "Machine Shop: Engine Lathe"

Student Manuals:

a. Georgia, Metal Fabrication Cluster, PLACE Package Title No. LO-1
b. Ohio, Machine Trades I, Engine Lathe Work Assignment Sheet #23
c. Machine Shop Training Course, Vol. I

Tools and Equipment:

a. Engine Lathe
b. Knurling tool

(Continued on back)

CLASSROOM HOURS

6

EVALUATION (MS-47)

a. Given all necessary tools, supplies and equipment, the student will be able to make diamond pattern knurls on a round workpiece to given specifications. The student will follow all necessary safety precautions.

b. V'TECS, Machine Shop, Task No. 107.

c. Georgia, Metal Fabrication Cluster, Teachers Edition.

INSTRUCTIONAL MATERIALS

Tools and Equipment:

c. Lubricant
d. Measuring tools
e. Safety goggles

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TASK

MS-48 Cutting off on the engine lathe

PERFORMANCE OBJECTIVE

Perform cutting off operations on the engine lathe.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Recessing, grooving and parting
b. Types of tools
c. Squaring cut off tools with the work
d. Housekeeping
e. Lubrication
f. Step-parting
g. Chatter
h. Speeds
i. Safety

Provide Demonstration On:

Cutting a groove

Provide Practical Application On:

Cut a groove on a rough workpiece to given specifications.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

Student Manuals:

a. Ohio, Machine Trades I, Engine Lathe Assignment Sheet #24
b. Machine Shop Training Course, Vol. I

Tools and Equipment:

a. Engine lathe
b. Cut off tools
c. Lubricant
d. Safety goggles

CLASSROOM HOURS

6

EVALUATION (MS-48)

Given all necessary tools, supplies and equipment, the student will be able to cut a groove to specified dimensions on the engine lathe.

TASK

MS-49 Identifying thread cutting devices

PERFORMANCE OBJECTIVE

Identify thread cutting devices on the engine lathe.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Procedure for threading on a lathe
b. Setting up the lathe for threading
    1. Setting dials on the compound and cross-feed
    2. Setting apron controls
c. Spindle speeds
d. Cutting the thread
e. Left-hand threads
f. Multiple point tool
g. Picking up a thread

Provide Demonstration On:

a. Setting the lathe for cutting threads
b. Cutting threads

Provide Practical Application On:

Set up the lathe for cutting a specified thread and cut the thread.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

A/Vs:

a. Bergwall, filmstrip #501-6, "The Lathe Explained"
b. Prentice-Hall, filmstrip #XF928, "Machine Shop: Engine Lathe"

Student Manuals:

a. Ohio, Machine Trades I, Engine Lathe Work Assignment Sheet #25
b. Machine Shop Training Course, Vol. I

Tools and Equipment:

a. Lathe
b. Thread cutting tool
c. Safety goggles

CLASSROOM HOURS

2

EVALUATION (MS-49)

Given all necessary tools and equipment, the student will be able to set up and operate the lathe to cut a specified thread to correct dimensions.

TASK

MS-50 Identifying the parts of a thread

PERFORMANCE OBJECTIVE

Identify the parts of a thread.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Major diameter of a screw
b. Pitch
c. Root and crest
d. Pitch diameter
e. Thread identification
f. Thread depth
g. Sharp-Vee thread form
h. Unified and American National Forms
i. Metric Threads Forms
j. Tolerance symbols

Provide Demonstration On:

Identifying thread designations

Provide Practical Application On:

a. Show the pitch diameter of a screw.
b. Show the depth of a thread on a drawing.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe

Student Manuals:

a. Ohio, Machine Trades I, Engine Lathe Work Assignment Sheet #26
b. Machine Shop Training Course, Vol. I

CLASSROOM HOURS

2

EVALUATION (MS-50)

Given a drawing of a screw, the student will be able to correctly identify the following dimensions on the screw according to the instructor's specifications.

a. Major diameter
b. Pitch
c. Root and crest
d. Pitch diameter
e. Helix angle
f. Thread depth

TASK

MS-51 Identifying American National thread standards

PERFORMANCE OBJECTIVE

Identify American National thread standards.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Brief history of National Screw Thread Commission
b. Advantages of American National thread form
c. Included angle
d. National form thread series
e. Symbols used in specifying American thread standards
f. Coarse and fine threads

Provide Demonstration On:

Designating American National threads

Provide Practical Application On:

Designate American National threads given basic dimensions.

INSTRUCTIONAL MATERIALS

Textbooks:

Kibbe

Student Manuals:

a. Ohio, Machine Trades 1, Engine Lathe Work Assignment Sheet #27
b. Machine Shop Training Course, Vol. I

CLASSROOM HOURS 2

EVALUATION (MS-51)

Given basic dimensions, the student will be able to correctly specify American National Thread form designation for the thread.

TASK

MS-52 Computing American National thread form

PERFORMANCE OBJECTIVE

Compute formulas for American National thread forms.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. American National thread forms
b. Formulas for
    1. Pitch
    2. Diameter
    3. Major diameter
    4. Minor or root diameter
    5. Root and crest
    6. Single depth
    7. Double depth

Provide Demonstration On:

Computing formulas for
a. Pitch
b. Diameter
c. Major diameter
d. Minor or root diameter
e. Root and crest flats
f. Single depth
g. Double depth

Provide Practical Application On:

Compute formulas for
a. Pitch
b. Diameter
c. Major diameter
d. Minor or root diameter

(Continued on back)

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe

Student Manuals:

a. Ohio, *Machine Trades I*, Engine Lathe Work Assignment Sheet #28
b. *Machine Shop Training Course*, Vol. I

CLASSROOM HOURS 2

EVALUATION (MS-52)

Given basic dimensions for American National Form threads, the student will be able to correctly compute the following

a. Pitch
b. Pitch diameter
c. Major diameter
d. Minor or root diameter
e. Root and crest flats
f. Single depth
g. Double depth

INSTRUCTIONAL ACTIVITIES

Provide Practical Application On:

e. Root and crest flats
f. Single depth
g. Double depth

TASK

MS-53 Computing sharp V-thread formulas

PERFORMANCE OBJECTIVE

Compute sharp V-thread formulas from an example.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Sharp V-thread
b. Dimensions
    1. Thread angle
    2. Pitch
    3. Depth
    4. Major diameter
    5. Pitch diameter
    6. Minor diameter
    7. Crest
    8. Side
    9. Root
c. Formulas
    1. Thread angle
    2. Pitch
    3. Depth
    4. Minor diameter
    5. Pitch diameter
    6. Major diameter

Provide Demonstration On:

Measuring and computing
a. Thread angle
b. Pitch
c. Depth
d. Minor diameter
e. Pitch diameter
f. Major diameter

Provide Practical Application On:

Measure and compute.
a. Thread angle
b. Pitch
c. Depth
d. Minor diameter
e. Pitch diameter
f. Major diameter

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe

Student Manuals:

a. Ohio, Machine Trades I, Engine Lathe Work Assignment Sheet #29
b. Machine Shop Training Course, Vol. I

Tools and Equipment:

a. Sharp V-thread screws
b. Measuring tools

CLASSROOM HOURS 2

EVALUATION (MS-53)

Given a screw which has sharp V-thread dimensions and appropriate measuring tools, the student will be able to compute the following dimensions accurately.

a. Thread angle
b. Pitch
c. Depth
d. Minor diameter
e. Pitch diameter
f. Major diameter

TASK

MS-54 Identifying Acme threads

PERFORMANCE OBJECTIVE

Identify Acme threads and compute dimensions.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Acme thread
b. Advantages of Acme thread form
c. Application of Acme thread
d. Depth vs pitch
e. Classes
  1. 2G
  2. 3G
  3. 4G
f. Included angle
g. Formulas for pitch, depth and width

Provide Demonstration On:

a. Measuring an Acme threaded screw with a wire gage
b. Figuring pitch, depth and width of an Acme thread

Provide Practical Application On:

a. Measure an Acme thread with a wire thread gage.
b. Figure pitch, depth and width of an Acme thread.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

Student Manuals:

a. Ohio, Machine Trades I, Engine Lathe Work Assignment Sheet #30
b. Machine Shop Training Course, Vol. I

Tools and Equipment:

Wire thread gage

CLASSROOM HOURS 2

EVALUATION (MS-54)

Given a screw or bolt with an Acme thread form and appropriate gages, the student will be able to accurately measure the screw or bolt and identify the pitch, depth and width of the threads.

TASK

MS-55 Using the Acme tap

PERFORMANCE OBJECTIVE

Identify Acme tap drill sizes and use the Acme tap.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Figuring the outside diameter of an Acme internal
b. Setting the compound
c. Using an Acme screw plug gage
d. Purpose of an Acme tap
e. Tap sets
f. Tapping steel (an oil)
g. Tapping bronze (no lubricant)

Provide Demonstration On:

Using the Acme tap to cut
a. Steel
b. Bronze

Provide Practical Application On:

Use the Acme tap to cut an internal thread to specifications.
a. Steel
b. Bronze

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

A/Vs:

Bergwall, filmstrip #505-5, "Bench Metal Work"

Student Manuals:

Ohio, Machine Trades I, Engine Lathe Work Assignment Sheet #31

Tools and Equipment:

a. Acme tap set
b. Lubricating oil

CLASSROOM HOURS

4

EVALUATION (MS-55)

Given an Acme tap set, bronze and steel work stock, lubricating oil, necessary tools and specifications, the student will be able to tap Acme internal threads as specified in steel and bronze material, using lubrication when required.

TASK

MS-56 Identifying square threads

PERFORMANCE OBJECTIVE

Identify and figure dimensions of square threads.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Square threads
   1. Purpose
   2. Applications
b. Depth vs pitch
c. Flank clearance
d. Clearance on major diameter
e. Figuring thickness
f. Figuring pitch, width and depth

Provide Demonstration On:

Figuring the following dimensions on square thread
a. Pitch
b. Width
c. Depth

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

Student Manuals:

a. Ohio, Machine Trades I, Engine Lathe Work Assignment Sheet #32
b. Machine Shop Training Course, Vol. I

Tools and Equipment:

a. Bolt with square thread
b. Measuring tools

CLASSROOM HOURS

2

EVALUATION (MS-56)

Given a square threaded bolt and appropriate measuring tools, the student will be able to correctly figure the pitch, width and depth of the square thread.

TASK

MS-57 Identifying classes of fits of screw threads

PERFORMANCE OBJECTIVE

Identify the classes of fits of screw threads.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. General thread fitting requirements
b. Unified National Course (UNC)
c. Unified National Fine (UNF)
d. Unified National Special (UNS)
e. Classes
    1. 1A, 2A, 3A
    2. 1B, 2B, 3B
f. Identifying screw thread designations

Provide Demonstration On:

Identifying screw thread designations

Provide Practical Application On:

Select a specified screw thread bolt, identify the classification correctly and identify applications.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

Student Manuals:

Ohio, Machine Trades I, Engine Lathe Assignment Sheet #33

Tools and Equipment:

Selection of various sizes of threaded bolts

CLASSROOM HOURS

2

EVALUATION (MS-57)

Given specifications and a selection of threaded bolts, the student will be able to correctly identify the screw thread classification and identify general applications of the type of screw threads.

TASK

MS-58 Using thread gages

PERFORMANCE OBJECTIVE

Use thread pitch gages, center gages and plug and ring gages.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Thread pitch gages
    1. Applications
    2. Reading
b. Center gages
    1. Procedure for use
    2. Applications
c. Plug and ring thread gages
    1. Applications
    2. Procedures for use

Provide Demonstration On:

Using the following gages to gage threads
a. Thread pitch gage
b. Center gages
c. Plug and ring gages

Provide Practical Application On:

Use the following gages to gage assigned threaded bolts.
a. Thread pitch gages
b. Center gage
c. Plug and ring gages

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

A/Vs:

a. Bergwall, filmstrip #501-6, "The Lathe Explained"
b. Prentice-Hall, filmstrip #XF928, "Machine Shop: Engine Lathe"

Student Manuals:

Ohio, Machine Trades I, Engine Lathe Work Assignment Sheet #34

Tools and Equipment:

a. Thread pitch gage
b. Center gages
c. Plug and ring thread gage
d. Threaded bolts

CLASSROOM HOURS 4

EVALUATION (MS-58)

Given a series of assigned threaded bolts, the student will be able to use the following gages to accurately measure screw threads.

1. Pitch
2. Center gage
3. Plug and ring thread gage

TASK

MS-59 Using a thread micrometer

PERFORMANCE OBJECTIVE

Use a thread micrometer to measure sharp V and American National threads.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Thread micrometer
   1. Purpose
   2. Parts
   3. Accuracy
b. Thread comparator
   1. Description
   2. Purpose
c. Using the thread micrometer
   1. Points of measurement
   2. Reading the scales

Provide Demonstration On:

Using a thread micrometer

Provide Practical Application On:

Use a thread micrometer to measure assigned threads.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Porter
c. Kibbe

Student Manuals:

a. Ohio, Machine Trades I, Engine Lathe Work Assignment Sheet #35
b. Machine Shop Training Course, Vol. I

Tools and Equipment:

a. Thread micrometer
b. Threaded bolts

CLASSROOM HOURS

4

EVALUATION (MS-59)

Given a thread micrometer, the student will be able to accurately measure assigned sizes of threads.

TASK

MS-60 Measuring threads with the three wire method

PERFORMANCE OBJECTIVE

Measure threads using the three wire method.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. The three wire method
b. "Best wire size"
c. Formula for pitch diameter
d. Three wire gauging sets
e. Formula for best wire size

Provide Demonstration On:

a. Figuring best wire size
b. Figuring pitch diameter with the three wire method

Provide Practical Application On:

Use the three wire method to figure pitch diameter of threads.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

A/Vs:

a. Bergwall, filmstrip #501-6, "The Lathe Explained"
b. Prentice-Hall, filmstrip #XF 928, "Machine Shop: Engine Lathe"

Student Manuals:

a. Ohio, Machine Trades I, Engine Lathe Work Assignment Sheet #36
b. Machine Shop Training Course, Vol. I

Tools and Equipment:

a. Three wire gage set
b. Threaded bolts

CLASSROOM HOURS

2

EVALUATION (MS-60)

Given a three wire gage set and an assigned set of bolts or other threaded items, the student will be able to use the three wire method to accurately gage the threads.

TASK

MS-61 Cutting threads with an even geared lathe

PERFORMANCE OBJECTIVE

Make all computations and cut threads on an even geared lathe.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Even geared lathes (change gear type)
b. Calculating change gears on an even geared lathe
c. Determining number of threads on lead screws
d. Cutting threads on the even geared lathe
e. Changing gears

Provide Demonstration On:

a. Calculating change gears on an even geared lathe
b. Changing gears
c. Cutting thread

Provide Practical Application On:

Make all necessary calculations and settings for cutting threads on an even geared lathe.

INSTRUCTIONAL MATERIALS

Textbooks:

Kibbe

A/Vs:

a. Bergwall, filmstrip #501-6, "The Lathe Explained"
b. Prentice-Hall, filmstrip #XF928, "Machine Shop: Engine Lathe"

Student Manuals:

a. Georgia, Metal Fabrication Cluster, PLACE Package Title No. LO-5, LO-6
b. Ohio, Machine Trades I, Engine Lathe Work Assignment Sheet #37
c. Machine Shop Training Course, Vol. I
d. Georgia, Metals Fabrication Mathematics

Tools and Equipment:

(Continued on back)

CLASSROOM HOURS

4

EVALUATION (MS-61)

a. Given all necessary tools, supplies and equipment, the student will be able to make all necessary calculations and settings to cut threads on an even geared lathe to given instructor specifications.

b. Georgia, Metal Fabrication Cluster, Teachers Edition.

INSTRUCTIONAL MATERIALS

Tools and Equipment:

a. Lathe
b. Round stock to be threaded

TASK

MS-62 Cutting threads on a lathe which is not even geared

PERFORMANCE OBJECTIVE

Compute all formulas for thread cutting with change gears on a lathe which is not even geared.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Formula for figuring change gears on lathe which is not even geared
b. Even geared lathes
c. Lead numbers
d. Change gears
e. Idle gears
f. Tumbler gears
g. Compound gears

Provide Demonstration On:

a. Figuring gears required to cut a thread
b. Changing out gears
c. Cutting threads

Provide Practical Application On:

Compute formulas for and set up an uneven geared lathe to cut threads to specified dimensions.

INSTRUCTIONAL MATERIALS

Textbooks:

Kibbe

A/Vs:

a. Bergwall, filmstrip #501-6, "The Lathe Explained"
b. Prentice-Hall, filmstrip #XF928, "Machine Shop: Engine Lathe"

Student Manuals:

a. Ohio, Machine Trades I, Engine Lathe Work Assignment Sheet #38
b. Georgia, Metals Fabrication Mathematics

Tools and Equipment:

a. Uneven geared lathe
b. Gears
c. Wrenches

(Continued on back)

CLASSROOM HOURS 4

EVALUATION (MS-62)

Given all necessary tools, supplies and equipment, the student will be able to compute all formulas and set up an uneven geared lathe to cut threads to specified dimensions.

INSTRUCTIONAL MATERIALS

Tools and Equipment:

d. Threading tool
e. Workstock
g. Safety goggles

TASK

MS-63 Cutting threads on a quick-change gear lathe

PERFORMANCE OBJECTIVE

Cut threads on a quick-change gear lathe.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Thread and feed plate
    1. Description and purpose
    2. Location
b. Quick-change gear
    1. Purpose
    2. Advantage
c. Procedure for setting up quick-change gear lathe
d. Formulas for thread cutting with quick-change gear lathe
e. Double lead screw

Provide Demonstration On:

Setting up the quick-change gear lathe to cut threads

Provide Practical Application On:

Set up and cut threads on a quick-change gear lathe.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe

A/Vs:

a. Bergwall, filmstrip #501-6, "The Lathe Explained"
b. Prentice-Hall, filmstrip #XF928, "Machine Shop: Engine Lathe"

Student Manuals:

a. Ohio, Machine Trades I, Engine Lathe Work Assignment Sheet #40
b. Machine Shop Training Course, Vol. I

Tools and Equipment:

Quick-change gear lathe

CLASSROOM HOURS

4

EVALUATION (MS-63)

Given a quick-change gear lathe and all necessary tools, supplies and equipment, the student will correctly set up the lathe and cut threads on an assigned workpiece.

TASK

MS-64 Identifying multiple lead screw threads

PERFORMANCE OBJECTIVE

Identify multiple lead screw threads.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Multiple lead screw threads
    1. Description
    2. Purpose
    3. Lead
    4. Pitch
b. Applications of
    1. Single lead screws
    2. Double lead screws
    3. Triple lead screws
    4. Multiple lead screws

Provide Practical Application On:

Identify parts and dimensions of multiple lead screws.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

A/Vs:

a. Bergwall, filmstrip #501-6, "The Lathe Explained"
b. Prentice-Hall, filmstrip #XF928, "Machine Shop: Engine Lathe"

Student Manuals:

Ohio, Machine Trades I, Engine Lathe Work Assignment Sheet #41

Tools and Equipment:

a. Examples of multiple lead screws
b. Measuring tools

CLASSROOM HOURS

2

EVALUATION (MS-64)

Given several multiple lead screws, the student will be able to identify the parts of the screw and measure dimensions.

TASK

MS-65 Cutting left hand threads

PERFORMANCE OBJECTIVE

Cut left hand threads on the engine lathe.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Lathe set-up for left hand threads
b. Symbols used for left hand threads
c. Necking a shaft
d. Left hand dies and taps

Provide Demonstration On:

Cutting left hand threads using
a. Threading tool
b. Dies
c. Taps

Provide Practical Application On:

Cut left hand threads on the lathe using
a. Threading tool
b. Dies
c. Taps

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

A/Vs:

a. Bergwall, filmstrip #501-6, "The Lathe Explained"
b. Prentice-Hall, filmstrip #XF928, "Machine Shop: Engine Lathe"

Student Manuals:

Ohio, Machine Trades I, Engine Lathe Work Assignment Sheet #42

Tools and Equipment:

a. Lathe and tools to cut left hand threads
b. Left hand dies and taps

CLASSROOM HOURS 4

EVALUATION (MS-65)

Given an engine lathe and all appropriate tools, supplies and materials, the student will be able to cut left hand threads to specified dimensions.

TASK

MS-66 Determining a tap drill size

PERFORMANCE OBJECTIVE

Determine a tap drill size for tap drilling on the engine lathe.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Tap drills
   1. Description
   2. Use
b. Formula for tap drill size of American Standard Screw Thread
c. 75% rule
d. Problems of tapping
e. Using a tap drill when exact size is not available
f. Safety

Provide Demonstration On:

Computing tap drill size for a specified job

Provide Practical Application On:

Compute tap drill size for a specified job.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

A/Vs:

a. Bergwall, filmstrip #501-6, "The Lathe Explained"
b. Prentice-Hall, filmstrip #XF928, "Machine Shop: Engine Lathe"

Student Manuals:

a. Ohio, Machine Trades I, Engine Lathe Work Assignment Sheet #43
b. Machine Shop Training Course, Vol. II

CLASSROOM HOURS

2

EVALUATION (MS-66)

Given specifications for a tapping operation, the student will be able to select the appropriate size tap drill for the job.

TASK

MS-67 Cutting internal threads and tapping

PERFORMANCE OBJECTIVE

Cut internal threads and perform tapping operation on a lathe.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types of steel used to make taps
b. Cutting internal threads on a lathe
    1. Setting the compound
    2. Lubricants used
c. Using the center gage
d. Blind holes (gaging)
e. Truing up the work
f. Chatter
g. Using the graduated collar for internal threading
h. Safety

Provide Demonstration On:

a. Cutting internal threads on an engine lathe
b. Tapping on an engine lathe

Provide Practical Application On:

Perform internal thread cutting and tapping operations on the engine lathe.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

A/Vs:

a. Bergwall, filmstrip #501-6, "The Lathe Explained"
b. Prentice-Hall, filmstrip #XF928, "Machine Shop: Engine Lathe"

Student Manuals:

a. Georgia, Metal Fabrication Cluster, PLACE Package Title No. OLO-2
b. Ohio, Machine Trades I, Engine Lathe Work Assignment Sheet #44

Tools and Equipment:

a. Engine lathe
b. Bored workpiece
c. Depth gage

(Continued on back)

CLASSROOM HOURS

6

EVALUATION (MS-67)

a. Given all necessary tools, supplies and equipment, the student will be able to cut internal threads to specified dimensions and correctly perform tapping of the internal threads.

b. V'TECS, Machine Shop, Task No. 92.

c. Georgia, Metal Fabrication Cluster, Teachers Edition.

INSTRUCTIONAL MATERIALS

Tools and Equipment:

d. Center gage
e. Thread cutting tools
f. Tapping set
g. Safety goggles

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TASK

MS-68 Identifying principles of taper turning

PERFORMANCE OBJECTIVE

Identify basic principles of taper turning and common tapers on the engine lathe.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Uses of taper
b. Taper series
  1. Brown
  2. Sharpe
  3. Morse
c. Taper sizes
d. Tapering methods
  1. Compound slide method
  2. Offset tail stock method
  3. Taper attachment method
e. Procedure for setting up the taper attachment
f. Measurement tapers

Provide Demonstration On:

a. Figuring amount of taper in taper per foot (TPF)
b. Setting up the taper attachment
c. Measuring tapers

Provide Practical Application On:

Figure the amount of taper for a specified job (in TPF), set up the taper attachment and be able to measure tapers.

INSTRUCTIONAL MATERIALS

Textbooks:

Kibbe

A/Vs:

a. Bergwall, filmstrip #501-5, "The Lathe Explained"
b. Prentice-Hall, filmstrip #XF928, "Machine Shop: Engine Lathe"

Student Manuals:

a. Georgia, Metal Fabrication Cluster, PLACE Package Title No. LO-3
b. Ohio, Machine Trades I, Engine Lathe Assignment Sheet #45
c. Machine Shop Training Course, Vol. I

Tools and Equipment:

a. Engine lathe

(Continued on back)

CLASSROOM HOURS

5

EVALUATION (MS-68)

a. Given appropriate tools, supplies and equipment, the student will be able to calculate a specified taper in (TPF), correctly set up the taper attachment on the engine lathe for a specified taper and be able to use assigned measuring instruments to measure given tapers accurately.

b. V'TECS, Machine Shop, Task No. 90.

c. Georgia, Metal Fabrication Cluster, Teachers Edition.

INSTRUCTIONAL MATERIALS

Tools and Equipment:

b. Taper attachment
c. Inside and outside taper micrometers
d. Sine bar and gage blocks
e. Ring gage

TASK

MS-69 Computing tapers

PERFORMANCE OBJECTIVE

Compute tapers in taper per foot (TPF).

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Formula for finding taper per foot (TPF)
b. Taper length formula
c. Finding taper per inch (TPI)

Provide Demonstration On:

a. Computing TPF
b. Converting to TPI
c. Computing taper length

Provide Practical Application On:

From basic dimensions, compute a taper in terms of taper per foot (TPF), taper per inch (TPI) and taper length.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

A/Vs:

a. Bergwall, filmstrip #505-5, "The Lathe Explained"
b. Prentice-Hall, filmstrip #XF928, "Machine Shop: Engine Lathe"

Student Manuals:

a. Ohio, Machine Trades I, Engine Lathe Work Assignment Sheet #46
b. Machine Shop Training Course, Vol. I

CLASSROOM HOURS

1

EVALUATION (MS-69)

Given basic dimensions for a tapering operation, the student will be able to make correct computations for taper in terms of taper per foot, taper per inch and taper length.

TASK

MS-70 Measuring short tapers

PERFORMANCE OBJECTIVE

Measure short or abrupt tapers.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Angles
    1. Right angle
    2. Acute angle
    3. Obtuse angle
b. Dimensioning of abrupt tapers on mechanical drawings
c. Vernier bevel protractor
d. Sine bar
e. Formula for taper angle for sharp pointed taper
f. Formula for taper angle when TPF is known
g. Vertex of an angle

Provide Demonstration On:

a. Measuring a sharp pointed taper
b. Computing taper from TPF

Provide Practical Application On:

a. Measure a sharp pointed taper.
b. Compute taper given TPF.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

A/Vs:

a. Bergwall, filmstrip #505-5, "The Lathe Explained"
b. Prentice-Hall, filmstrip #XF928, "Machine Shop: Engine Lathe"

Student Manuals:

a. Ohio, Machine Trades I, Engine Lathe Work Assignment Sheet #47
b. Machine Shop Training Course, Vol. I

Tools and Equipment:

a. Vernier bevel protractor
b. Sine bar and blocks

CLASSROOM HOURS 5

EVALUATION (MS-70)

a. Given a sharp pointed taper and all necessary measuring tools, the student will be able to correctly measure and compute the taper.

b. Given the taper per foot of a taper, the student will be able to correctly compute the taper angle to the instructor's satisfaction.

TASK

MS-71 Gaging inside and outside tapers

PERFORMANCE OBJECTIVE

Gage inside and outside tapers using taper ring, plug gages and micrometers.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Gaging tapers
b. Gaging tapered bores
c. Taper plug gage
d. Taper ring gage
e. Using chalk or prussian blue
f. Taper micrometers
    1. Inside
    2. Outside

Provide Demonstration On:

a. Using the plug gage
b. Using the ring gage
c. Using taper micrometers

Provide Practical Application On:

Measure tapers using
a. Pluggage
b. Ring gage
c. Taper micrometers (inside and outside)

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

A/Vs:

a. Bergwall, filmstrip #505-5, "The Lathe Explained"
b. Prentice-Hall, filmstrip #XF928, "Machine Shop: Engine Lathe"

Student Manuals:

Ohio, Machine Trades I, Engine Lathe Work Assignment Sheet #48

Tools and Equipment:

a. Taper ring and plug gages
b. Taper micrometers

CLASSROOM HOURS 4

EVALUATION (MS-71)

Given an assigned set of inside and outside tapers, the student will be able to measure inside and outside tapers accurately using pluggages, ring gages, inside and outside taper micrometers.

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TASK

MS-72 Tapering by the offset tail stock method

PERFORMANCE OBJECTIVE

Turn a taper on the lathe using the offset tail stock method.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types of tapers which are turned using offset tail stock method
b. Formulas for offset
  1. Given TPI
  2. Given TPF
  3. General formula
c. Turning a taper between centers
d. Measuring the offset
e. Using the cross slide

Provide Demonstration On:

Turning a taper using the offset tail stock method

Provide Practical Application On:

Turn a taper using the offset tail stock method.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

A/Vs:

a. Bergwall, filmstrip #505-5, "The Lathe Explained"
b. Prentice-Hall, filmstrip #XF 928, "Machine Shop: Engine Lathe"

Student Manuals:

a. Georgia, Metal Fabrication Cluster, PLACE Package Title No. LO-7
b. Ohio, Machine Trades I, Engine Lathe Work Assignment Sheet #49
c. Machine Shop Training Course, Vol. I

Tools and Equipment:

a. Lathe

(Continued on back)

CLASSROOM HOURS 2

EVALUATION (MS-72)

a. Given all necessary tools, equipment and supplies, the student will be able to turn a taper on the engine lathe using the off-set tail stock method to specified dimensions.

b. Georgia, Metal Fabrication Cluster, Teachers Edition.

INSTRUCTIONAL MATERIALS

Tools and Equipment:

b. Rules
c. Dial indicator
d. Safety goggles

TASK

MS-73 Cutting a taper with the compound rest

PERFORMANCE OBJECTIVE

Cut a taper with the compound rest on the engine lathe.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Setting the cutting tool on center
b. Compound rest method of cutting a taper
    1. Procedure
    2. Applications
c. Procedure for feeding the tool
d. Positions of zero on compound rest
e. Safety

Provide Demonstration On:

Cutting a taper using the compound rest method

Provide Practical Application On:

Cut a taper on the engine lathe using the compound rest method.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

A/Vs:

a. Bergwall, filmstrip #505-5, "The Lathe Explained"
b. Prentice-Hall, filmstrip #XF928, "Machine Shop: Engine Lathe"

Student Manuals:

a. Ohio, Machine Trades I, Engine Lathe Work Assignment Sheet #50
b. Machine Shop Training Course, Vol. I

Tools and Equipment:

a. Engine lathe
b. Workstock
c. Cutting tool
d. Safety goggles
e. Measuring instruments

CLASSROOM HOURS 4

EVALUATION (MS-73)

Given all necessary tools, equipment and materials, the student will be able to cut a taper on the engine lathe using the compound rest method. The taper must be cut to instructor specified dimensions.

TASK

MS-74 Cutting a taper with the taper attachment

PERFORMANCE OBJECTIVE

Cut a taper on the engine lathe using a taper attachment.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. The taper attachment
b. Advantages of using the taper attachment
c. Reading graduations on the swivel bar
d. Locking the swivel bar
e. "Lost Motion"

Provide Demonstration On:

a. Setting the swivel bar correctly
b. Making a trial cut

Provide Practical Application On:

Cut a taper on the engine lathe using a taper attachment.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

A/Vs:

a. Bergwall, filmstrip #505-5, "The Lathe Explained"
b. Prentice-Hall, filmstrip #XF928, "Machine Shop: Engine Lathe"

Student Manuals:

a. Georgia, Metal Fabrication Cluster, PLACE Package Title No. LO-4.
b. Ohio, Machine Trades I, Engine Lathe Work Assignment Sheet #51

Tools and Equipment:

a. Engine lathe
b. Taper attachment
c. Measuring tools

CLASSROOM HOURS

4

EVALUATION (MS-74)

Given all necessary tools, equipment and materials, the student will be able to cut a taper to specified dimensions on the engine lathe using a taper attachment.

TASK

MS-75 Boring or turning internal tapers

PERFORMANCE OBJECTIVE

Bore or turn internal tapers on the engine lathe.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Boring internal tapers
   1. Compound slide method
   2. Taper attachment method
b. "Lost Motion"
c. Gaging internal taper
d. Finishing internal tapers

Provide Demonstration On:

Boring an internal taper

Provide Practical Application On:

Bore an internal taper to specified dimensions.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe

A/Vs:

a. Bergwall, filmstrip #505-5, "The Lathe Explained"
b. Prentice-Hall, filmstrip #XF928, "Machine Shop: Engine Lathe"

Student Manuals:

Ohio, Machine Trades I, Engine Lathe Work Assignment Sheet #52

Tools and Equipment:

a. Engine lathe and cutting tools
b. Workstock
c. Safety goggles
d. Gages

CLASSROOM HOURS

4

EVALUATION (MS-75)

a. Given all necessary tools, equipment and materials, the student will be able to bore and finish an internal taper to specified dimensions.

b. V'TECS, Machine Shop, Task No 94.

TASK

MS-76 Identifying coolants and cutting components

PERFORMANCE OBJECTIVE

Identify coolants and cutting compounds and be able to choose a coolant or compound for a given job.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Coolants
b. Cutting compounds
c. Functions of a cutting compound
d. Emulsifying or soluble oils
e. Methods of coolant application
f. When to use a coolant or cutting compound

Provide Demonstration On:

a. Choosing a cutting compound
b. Choosing a coolant

Provide Practical Application On:

Choose a coolant or cutting compound for specified lathe work.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe
c. Porter

A/Vs:

Prentice-Hall, filmstrip #XF928, "Machine Shop: Engine Lathe"

Student Manuals:

a. Ohio, *Machine Trades I*, Engine Lathe Work Assignment Sheet #53.
b. *Machine Shop Training Course*, Vol. I

Tools and Equipment:

a. Coolant catalog
b. Cutting compound catalog

CLASSROOM HOURS

2

EVALUATION (MS-76)

Given specifications for a specific job to be done on the lathe, the student will be able to identify the appropriate coolant or cutting compound and be able to describe the method or application.

TASK

MS-77 Identifying lubricants

PERFORMANCE OBJECTIVE

Identify lubricants and greases used on the engine lathe.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Wear on machine tools
b. Properties of lubricating oils
c. When greases are used
d. Lubricants for ball and roller bearings
e. One-shot lubrication systems
f. Viscosity

Provide Demonstration On:

Choosing a lubricant or grease according to lubrication specifications for an engine lathe

Provide Practical Application On:

Choose a lubricant or grease for an assigned lathe in the lab according to specifications for the machine.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part I
b. Kibbe

A/Vs:

Bergwall, filmstrip #XF928
"Machine Shop: Engine Lathe"

Student Manuals:

Ohio, Machine Trades I, Engine Lathe Work Assignment Sheet #54

Tools and Equipment:

Manufacturer's lubricant and grease catalog

CLASSROOM HOURS

2

EVALUATION (MS-77)

Given an assigned engine lathe in the lab and lubrication specifications for the machine, the student will be able to correctly choose a lubricator grease for the machine.

TASK

MS-78 Identifying types, sizes, construction, specifications, nomenclature and range of work for milling machines

PERFORMANCE OBJECTIVE

Recognize types and sizes of milling machines and what kinds of work they do.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Functions of the milling machine
b. Column and knee type
c. Adjustable spindle type
d. Plain and universal machines
e. Vertical and horizontal mills
f. End and face milling
g. Column
h. Knee
i. Table
j. Spindle
k. Overarm
l. Coolants and cutting fluids

Provide Demonstration On:

Identifying parts and components on the machine

Provide Practical Application On:

Identify parts and functions of the milling machine.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part II
b. Porter
c. McCarthy
d. Kibbe

A/Vs:

a. Bergwall, filmstrip #502-1, "Milling Machine Explained"
b. Prentice-Hall, filmstrip #VD919-1, "Machine Shop: Horizontal Milling Machine"

Student Manuals:

a. Georgia, Metal Fabrication Cluster, PLACE Package Title No. VM-1, VM-2, VM-3, HM-1, HM-2, HM-3
b. Ohio, Machine Trades II, Milling Assignment Sheets #1, 8

Tools and Equipment:

a. Milling machine
b. Display of work done on a milling machine

CLASSROOM HOURS

5

EVALUATION (MS-78)

a. Given a milling machine with parts marked or tagged, the student will identify each tagged part and describe the function of each. One hundred percent accuracy is required.

b. Ohio, Machine Trades II, Instructor Manual.

c. Georgia, Metal Fabrication Cluster, Teachers Edition.

TASK

MS-79 Identifying milling machine work holding devices and their functions

PERFORMANCE OBJECTIVE

Identify and select a work holding device for a specific job.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Milling machine safety
b. Vises
   1. Flanged
   2. Plain
   3. Cam-action
   4. Swivel
   5. Toolmaker's vise
c. Fixtures
e. Importance of holding workpiece securely and accurately

Provide Demonstration On:

Selecting a work holding device for a given job

Provide Practical Application On:

a. Clean and place vise on bed.
b. Align vise by sight.
c. Fasten vise to bed with clamping bolts.
d. Place dial indicator attachment in mill spindle or magnetic tool holder.
e. Fasten dial indicator to attachment.
f. Indicate the fixed vise jaw.
g. Secure clamp bolts.
h. Recheck with indicator.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part II
b. Porter
c. Walker
d. Kibbe

A/Vs:

a. Bergwall, filmstrip #502-2 "Milling Machine Explained"
b. Prentice-Hall, filmstrip #VD919-2, "Machine Shop: Horizontal Milling Machine"; #VD920-1, "Machine Shop: Vertical Milling Machine"

Student Manuals:

a. Georgia, Metal Fabrication Cluster, PLACE Package Title No. VM-4, VM-6, HM-4, HM-6
b. Ohio, Machine Trades II, Milling Assignment Sheet #4

Tools and Equipment:

a. Milling machine
b. Selection of work holding devices
c. Stock
d. Measuring tools

CLASSROOM HOURS

3

EVALUATION (MS-79)

a. Given a milling machine and work holding devices, the student will identify each device and describe the type of work the device is used with. One hundred percent accuracy is required.

b. Ohio, Machine Trades II, Instructor Manual.

c. V'TECS, Machine Shop, Task No. 115.

d. Georgia, Metal Fabrication Cluster, Teachers Edition.

TASK

MS-80 Identifying, selecting and aligning milling machine attachments

PERFORMANCE OBJECTIVE

Identify, select and install a milling machine attachment.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Index head
b. Slotting attachment
c. Rotary table
d. High speed attachment
e. Rack milling attachment
f. Universal milling attachment

Provide Demonstration On:

Selecting and installing the attachment

Provide Practical Application On:

a. Replace draw bar with extended draw bar.
b. Drop quill approximately 3 inches and lock.
c. Insert 90 degree attachment driver in quill and tighten draw bar securely, being careful to align key with keyway.

(Continued on back)

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part II
b. Porter
c. Walker
d. Kibbe

A/Vs:

a. Bergwall, filmstrip #502-3,4,5, "Milling Machine Explained"
b. Prentice-Hall, filmstrip #VD919-5, "Machine Shop: Horizontal Milling Machine"; #VD920-4 "Machine Shop: Vertical Milling Machine"

Student Manuals:

Ohio, Machine Trades II, Milling Assignment Sheet #5

Tools and Equipment:

a. Milling machine
b. Selection of attachments
c. Measuring tools

CLASSROOM HOURS

8

EVALUATION (MS-80)

a. Given a milling machine and attachments, the student must select the correct attachment for a given job, install and align it. Attachment must be aligned to within ± 0.001".

b. Ohio, Machine Trades II, Instructor Manual.

c. V'TECS, Machine Shop, Task No. 116.

INSTRUCTIONAL ACTIVITIES

Provide Practical Application On:

d. Position indicating surface parallel with table movement.
e. Snug the two housing clamp bolts.
f. Attach magnetic base with dial indicator.
g. Indicate the 90 degree milling attachment for parallel alignment.
h. Secure housing clamp bolts.
i. Recheck step for accuracy.

TASK

MS-81 Selecting and setting up milling machine cutters and holders

PERFORMANCE OBJECTIVE

Identify and attach cutting tools and holders.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Milling cutters
   1. Spiral end mill
   2. Two lip end mill
   3. T-slot
   4. Woodruff key seat
   5. Involute spur-gear
   6. Plain
   7. Side
   8. Staggered tooth
   9. Slitting saw
   10. Angular

b. Arbors or holders
   1. End mill arbor
   2. Fly cutter arbor
   3. Standard arbor
   4. Face mill arbor
   5. Shell mill arbor

(Continued on back)

Provide Demonstration On:

Selecting and installing a cutter and holder

Provide Practical Application On:

Select and install a cutter and holder for a specific job.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part II
b. Porter
c. Walker
d. Kibbe

A/Vs:

a. Bergwall, filmstrip #502-2, "Milling Machine Explained"
b. Prentice-Hall, filmstrip #XF919-2, "Machine Shop: Horizontal Milling Machine"

Student Manuals:

a. Georgia, Metal Fabrication Cluster, PLACE Package Title No. VM-7, HM-7
b. Ohio, Machine Trades II, Milling Assignment Sheet #6

Tools and Equipment:

a. Milling machine
b. Cutters and holders
c. Measuring tools
d. Machinist's Handbook

CLASSROOM HOURS

10

EVALUATION (MS-81)

a. Given a milling machine and necessary tools and equipment, the student will select a cutter for a given job and install in the correct holder. Selection and installation must conform to Machinist's Handbook.

b. Ohio, Machine Trades II, Instructor Manual.

c. Georgia, Metal Fabrication Cluster, Teachers Edition.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

   6. Collet and adapter
   7. Standard arbor

c. Removing metal from the teeth of a cutter

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TASK

MS-82 Calculating cutting speeds and feeds for milling machine work

PERFORMANCE OBJECTIVE

Calculate cutting speeds and feeds.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Cutting speed
b. Cutting feed
c. Factors determining speed and feed
d. Tempered cutters
e. Carbide cutters
f. High speed steel cutters
g. Cutting speed formula
h. Rough and finish cuts

Provide Demonstration On:

Determining cutting speed and feed for a given job.

Provide Practical Application On:

a. Select and set speed
  1. Identify and classify material to be machined.
  2. Identify cutter to be used.
  3. Determine condition of milling machine.
  4. Determine depth of cut to be made.
  5. Establish material cutting speed.

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INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part II
b. Porter
c. Walker
d. Kibbe

A/Vs:

Prentice-Hall, filmstrip #VD919-3, "Machine Shop: Horizontal Milling Machine"

Student Manuals:

a. Georgia, Metal Fabrication Cluster, PLACE Package Title No. VM-5, HM-5
b. Ohio, Machine Trades II, Milling Assignment Sheet #7

Tools and Equipment:

a. Milling machine
b. Selection of cutters
c. Stock
d. Machinist's Handbook

CLASSROOM HOURS

4

EVALUATION (MS-82)

a. Given a milling machine and work assignment, the student will select the proper cutter and attachment, calculate the speed and feed and install. Selection, calculation and installation must conform to Machinist's Handbook.

b. Ohio, Machine Trades II, Instructor Manual.

c. V'TECS, Machine Shop, Task No. 137.

d. Georgia, Metal Fabrication Cluster, Teachers Edition.

INSTRUCTIONAL ACTIVITIES

Provide Practical Application On:

    6. Determine depth of cut to be made.
    7. Set speed according to operation manual.
- b. Select and set feed.
    1. Repeat steps 1-4 (item a) on previous page.
    2. Determine appropriate feed by using handbook tables.
    3. Set feed according to operation manual.

TASK

MS-83 Performing a plain milling operation

PERFORMANCE OBJECTIVE

Set up and square the sides of a rectangle.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Safety
b. Plain milling cutters
   1. Straight tooth
   2. Helical tooth
c. Slab milling
d. Direction cutter teeth revolve
e. Using the dial indicator to square up vise
f. Caution against moving cutter back over finished work
g. Speeds and feeds

Provide Demonstration On:

a. Selecting cutters and holders
b. Setting up machine
c. Squaring up vise
d. Making cuts

Provide Practical Application On:

a. Identify and classify workpiece material.
b. Mount and position vise.
c. Select and mount cutter.
d. Select and set up speed and feed.
e. Mount and align workpiece to cutter.

(Continued on back)

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part II
b. Porter
c. Walker
d. Kibbe

A/Vs:

a. Bergwall, filmstrip #502-4, "Milling Machine Explained"
b. Prentice-Hall, filmstrip #VD919-3, "Machine Shop: Horizontal Milling Machine"; #VD920-2, "Machine Shop: Vertical Milling Machine"

Student Manuals:

a. Georgia, Metal Fabrication Cluster, PLACE Package Title No. HM-10
b. Ohio, Machine Trades II, Milling Assignment Sheet #9

Tools and Equipment:

a. Milling machine
b. Plain milling cutters and arbors
c. Dial indicator
d. Vise
e. Workpiece

CLASSROOM HOURS

10

EVALUATION (MS-83)

a. Given a milling machine, a selection of cutters and necessary tools and equipment, the student will square up the sides of a rectangle. Finished measurement must be ± 0.001 " of given specifications.

b. Ohio, Machine Trades II, Instructor Manual.

c. V'TECS, Machine Shop, Task Nos. 115, 116, 139.

d. Georgia, Metal Fabrication Cluster, Teachers Edition.

INSTRUCTIONAL ACTIVITIES

Provide Practical Application On:

f. Make first cut.
g. Turn off machine, rotate workpiece to place finished side against fixed vise jaw and secure.
h. Make second cut to depth.
i. Measure for accuracy and place workpiece so that second finished surface (steps g and h) is on the bottom of the vise.
j. Make third cut.
k. Turn off machine, measure for accuracy and rotate workpiece.
l. Cut remaining side.
m. Measure for squareness and accuracy

TASK

MS-84 Performing a face milling operation

PERFORMANCE OBJECTIVE

Machine a flat surface using the face milling cutter.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Safety
b. Face milling operation
c. Right hand and left hand face milling cutters
d. Speeds
e. Vertical attachment and end mills
f. Mounting the cutter
    1. Stub arbor
    2. Bolted to spindle
g. Speeds and feeds
h. Work alignment

Provide Demonstration On:

a. Setting up machine
b. Selecting and mounting cutter
c. Mounting workpiece
d. Making a cut

Provide Practical Application On:

Set up and mill a flat surface to specifications.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part II
b. Porter
c. Walker
d. Kibbe

A/Vs:

Prentice-Hall, filmstrip #XF919-3, "Machine Shop: Horizontal Milling Machine"

Student Manuals:

a. Georgia, Metal Fabrication Cluster, PLACE Package Title No. VM-8, HM-8
b. Ohio, Machine Trades II, Milling Assignment Sheet #10

Tools and Equipment:

a. Milling machine
b. Face milling cutter and holder

(Continued on back)

CLASSROOM HOURS

10

EVALUATION (MS-84)

a. Given a milling machine, a selection of cutters and necessary tools and equipment, the student will perform a face milling operation to a tolerance of ± 0.001" to specifications. Finished work must be smooth and without gouges or marks.

b. Ohio, Machine Trades II, Instructor Manual.

c. Georgia, Metal Fabrication Cluster, Teachers Edition.

INSTRUCTIONAL MATERIALS

Tools and Equipment:

c. Measuring instruments
d. Work holder
e. Workpiece

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TASK

MS-85 Performing a side milling operation

PERFORMANCE OBJECTIVE

Machine a vertical surface with a side milling cutter.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Safety
b. Side milling operation
c. Side milling cutters
d. Speeds and feeds
e. Attachments
f. Holding devices
g. Work alignment

Provide Demonstration On:

a. Setting up machine
b. Selecting and mounting cutter
c. Mounting work piece
d. Making a cut

Provide Practical Application On:

Set up and mill a vertical surface to specifications.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part II
b. Porter
c. McCarthy
d. Kibbe

A/Vs:

Prentice-Hall, filmstrip #VD920-2, "Machine Shop: Vertical Milling Machine

Student Manuals:

Ohio, Machine Trades II, Milling Assignment Sheet #11

Tools and Equipment:

a. Milling machine
b. Side milling cutter and attachment
c. Measuring instruments
d. Work holder
e. Workpiece

CLASSROOM HOURS

10

EVALUATION (MS-85)

a. Given a milling machine, a selection of cutters and necessary tools and equipment, the student will perform a side milling operation to a tolerance of ± 0.001" to specifications. Finished work must be smooth and without gouges and marks.

b. Ohio, Machine Trades II, Instructor Manual.

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TASK

MS-86 Performing a form milling operation

PERFORMANCE OBJECTIVE

Machine an irregularly shaped surface with a form milling cutter.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Safety
b. Form milling operation
c. Form milling cutters
d. Speeds and feeds
e. Attachments
f. Holding devices
g. Work alignment

Provide Demonstration On:

a. Setting up machine
b. Selecting and mounting cutter
c. Mounting workpiece
d. Making a cut

Provide Practical Application On:

a. Secure a well-sharpened cutter of the proper form.
b. Mount the proper size arbor in the spindle. Be sure the taper on the arbor and spindle are clean.

(Continued on back)

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part II
b. Porter
c. McCarthy
d. Kibbe

Student Manuals:

Ohio, Machine Trades II, Milling Assignment Sheet #12

Tools and Equipment:

a. Milling machine
b. Form milling cutters and attachments
c. Measuring instruments
d. Work holders
e. Workpiece

CLASSROOM HOURS 10

EVALUATION (MS-86)

a. Given a milling machine, a selection of cutters and necessary tools and equipment, the student will perform a form milling operation to a tolerance of ± 0.001" to specifications. Finished work must be smooth and without gouges or marks.

b. Ohio, Machine Trades II, Instructor Manual.

c. V'TECS, Machine Shop, Task No. 132.

INSTRUCTIONAL ACTIVITIES

Provide Practical Application On:

c. Mount the cutter on the arbor. Special attention should be given to keys and keyways of the proper size.
d. Secure the overarm support as near the cutter as possible.
e. Secure the work to the machine by any acceptable work holding method. Be certain the work is square with the machine.
f. Position the work cutter in the desired position.
g. Determine the depth of cut.
h. Set the depth of cut, take the first cut and check the cut.
i. Reset if necessary to proper depth and securely lock the knee. This is done to prevent the table from moving up or down during the cut. The same may be done with the saddle cross slide to prevent transverse movement.
j. Finish machining the work to desired form. The spindle speed form milling should be about the same diameter and type of steel. The feed which is expressed in inches per minute should be less for form milling as the form cutters have coarser teeth. The coarser the teeth the less the feed so that each tooth will not be overworked.

TASK

MS-87 Performing an angular milling operation

PERFORMANCE OBJECTIVE

Machine a workpiece to a specified angle and height.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Safety
b. Angle
c. Angular milling cutters
d. Speeds and feeds
e. Attachments
f. Holding devices
g. Work alignment

Provide Demonstration On:

a. Setting up machine
b. Selecting and mounting cutter
c. Mounting workpiece
d. Making a cut

Provide Practical Application On:

a. Identify and classify workpiece material.
b. Mount and align angle plate.
c. Select and mount end mill cutter.
d. Select and set speed, feed, and depth of cut.
e. Make cut.

(Continued on back)

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part II
b. Porter
c. Kibbe

A/Vs:

Prentice-Hall, filmstrip #VD920-4, "Maching Shop: Vertical Milling Machine:

Student Manuals:

Ohio, Machine Trades II, Milling Assignment Sheet #13

Tools and Equipment:

a. Milling machine
b. Angular milling cutter and attachment
c. Measuring instruments
d. Work holder
e. Workpiece
f. Machinist's Handbook

CLASSROOM HOURS

10

EVALUATION (MS-87)

a. Given a milling machine, a selection of cutters and necessary tools and equipment, the student will perform an angular milling operation to a tolerance of ± 5 minutes. Finished work must be smooth and without gouges or marks.

b. Ohio, Machine Trades II, Instructor Manual.

c. V'TECS, Machine Shop, Task No. 125.

INSTRUCTIONAL ACTIVITIES

Provide Practical Application On:

f. Check surface and tolerance specifications, making machine adjustments when necessary.
g. Measure and inspect workpiece.

TASK

MS-88 Performing an end milling operation

PERFORMANCE OBJECTIVE

Machine all surfaces of a workpiece using an end milling cutter.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Safety
b. End milling operation
c. End milling cutters
d. Shell end mills
e. Speeds and feeds
f. Attachments
g. Holding devices
h. Work alignment

Provide Demonstration On:

a. Setting up machine
b. Selecting and mounting cutter
c. Mounting workpiece
d. Making a cut

Provide Practical Application On:

a. Identify and classify workpiece material.
b. Mount and align vise.
c. Secure workpiece in holding device.
d. Select and mount end mill cutter.
e. Select and set speed and feed.

(Continued on back)

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part II
b. Porter
c. Kibbe

A/Vs:

Bergwall, filmstrip #502-3, "Milling Machine Explained"

Student Manuals:

a. Georgia, Metal Fabrication Cluster, PLACE Package Title No. HM-10
b. Ohio, Machine Trades II, Milling Assignment Sheet #15

Tools and Equipment:

a. Milling machine
b. End milling cutter and attachment

(Continued on back)

CLASSROOM HOURS

10

EVALUATION (MS-88)

a. Given a milling machine, a selection of cutters and necessary tools and equipment, the student will perform an end milling operation machining all surfaces to a tolerance of ± 0.001 ". Finished work must be smooth and without gouges or marks.

b. Ohio, Machine Trades II, Instructor Manual.

c. V'TECS, Machine Shop, Task No. 130.

d. Georgia, Metal Fabrication Cluster, Teachers Edition.

INSTRUCTIONAL ACTIVITIES

Provide Practical Application On:

f. Align workpiece, touch off and set depth of cut.
g. Mill to prescribed lines, measure to ensure accuracy, and make necessary adjustments.
h. Mill to specifications.

INSTRUCTIONAL MATERIALS

Tools and Equipment:

c. Measuring instruments
d. Work holder
e. Workpiece
f. Machinist's Handbook

TASK

MS-89 Drilling, boring and reaming with the milling machine

PERFORMANCE OBJECTIVE

Drill a hole and ream or bore to specifications.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Safety
b. Accuracy obtained
c. Drilling, boring and reaming horizontally and vertically
d. Speeds and feeds
e. Attachments
f. Holding devices
g. Work alignment
h. Layout work
i. Determining hole sizes

Provide Demonstration On:

a. Setting up machine
b. Selecting and mounting attachments
c. Mounting a workpiece

Provide Practical Application On:

a. Drilling
   1. Mount and align holding device.
   2. Secure part in holding device.
   3. True in over first hole to be drilled.
   4. Set machine speed.
   5. Center-drill workpiece.

(Continued on back)

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part II
b. Walker
c. Kibbe

Student Manuals:

a. Georgia, Metal Fabrication Cluster, PLACE Package Title No. VM-9
b. Ohio, Machine Trades II, Milling Assignment Sheet #16

Tools and Equipment:

Milling machine

CLASSROOM HOURS

10

EVALUATION (MS-89)

a. Given a milling machine and necessary tools and equipment, the student will drill, ream and bore a hole to specifications. Holes must be centered and finished to a tolerance of ± 0.0005.

b. Ohio, Machine Trades II, Instructor Manual.

c. V'TECS, Machine Shop, Task Nos. 118, 119, 120.

d. Georgia, Metal Fabrication Cluster, Teachers Edition.

INSTRUCTIONAL ACTIVITIES

Provide Practical Application On:

6. Drill first hole.
7. Use mill graduated dials to step over and drill subsequent holes to specifications.

b. Boring
    1. Lay out hole location.
    2. Secure workpiece to table.
    3. True mill wiggler.
    4. Locate center of hole.
    5. Select and set speeds and feeds as necessary.
    6. Countersink workpiece.
    7. Drill pilot hole.
    8. Drill hole to allow for clearance in boring.
    9. Bore hole to dimensions.

c. Reaming
    1. Identify and classify workpiece material.
    2. Mount and align holding device.
    3. Secure and align workpiece.
    4. Select and set speed and feed (repeating as necessary).
    5. Center-drill workpiece.
    6. Drill workpiece to specifications.
    7. Ream hole to specifications.

TASK

MS 90 Performing sawing, slitting and cutting off operations with the milling machine

PERFORMANCE OBJECTIVE

Saw, slit and cut off metal to specifications.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Safety
b. Accuracy required
c. Attachments
d. Speeds and feeds
e. Gang slitting
f. Holding devices
g. Work alignments
h. Determining depth of cut and length of feed

Provide Demonstration On:

a. Setting up machine
b. Selecting and mounting cutters
c. Making a cut

Provide Practical Application On:

a. Identify and classify workpiece material.
b. Mount and align workpiece in holding device.
c. Select and mount cutter.
d. Select and set speed, feed, and depth of cut.
e. Align workpiece to cutter.

(Continued on back)

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part II
b. Porter
c. Walker
d. Kibbe

A/Vs:

Prentice-Hall, filmstrip #VD919-5, "Machine Shop: Horizontal Milling Machine"

Student Manuals:

Ohio, Machine Trades II, Milling Assignment Sheet #17

Tools and Equipment:

a. Milling machine
b. Cutters and attachments
c. Measuring instruments
d. Work holder
e. Workpiece
f. Machinist's Handbook

CLASSROOM HOURS

6

EVALUATION (MS-90)

a. Given a milling machine and necessary tools and equipment, the student will cut off a piece of metal to specifications.

b. Ohio, Machine Trades II, Instructor Manual.

c. V'TECS, Machine Shop, Task No. 127.

INSTRUCTIONAL ACTIVITIES

Provide Practical Application On:

f. Perform milling operation to specifications.
g. Measure finished part for accuracy.

TASK

MS-91 Performing keyseating and T-slot milling operations

PERFORMANCE OBJECTIVE

Cut a woodruff keyseat and a T-slot to specifications.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Safety
b. Accuracy required
c. Attachments
d. Speeds and feeds
e. Determining slot and seat sizes
f. Holding devices
g. Work alignment

Provide Demonstration On:

a. Setting up machine
b. Selecting and mounting cutters
c. Making a cut

Provide Practical Application On:

a. Key seating
  1. Mount, secure, and align vise to table.
  2. Select, mount and secure cutter.
  3. Set machine speed.
  4. Set center line of cutter on center line of shaft, close to holding device.

(Continued on back)

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part II
b. Porter
c. Walker
d. Kibbe

A/Vs:

Bergwall, filmstrip #502-3 "Milling Machine Explained"

Student Manuals:

a. Georgia, Metal Fabrication Cluster, PLACE Package Title No. VM-10
b. Ohio, Machine Trades II, Milling Assignment Sheet #18

Tools and Equipment:

a. Milling machine
b. Cutters and attachments
c. Measuring instruments

(Continued on back)

CLASSROOM HOURS

10

EVALUATION (MS-91)

a. Given a milling machine and necessary tools and equipment, the student will cut a woodruff keyseat and a T-slot to a tolerance of ± 0.005.

b. Ohio, Machine Trades II, Instructor Manual.

c. V'TECS, Machine Shop, Task No. 127.

d. Georgia, Metal Fabrication Cluster, Teachers Edition.

INSTRUCTIONAL ACTIVITIES

Provide Practical Application On:

5. Turn machine on and touch off.
6. Mill to prescribed depth and length.

b. T-slotting
   1. Identify and classify workpiece to table.
   2. Secure workpiece to table.
   3. Position slotting attachment over table.
   4. Select and secure cutter to spindle.
   5. Select and adjust stroke length.
   6. Align cutter to workpiece.
   7. Set speed.
   8. Slot to specifications

INSTRUCTIONAL MATERIALS

Tools and Equipment:

d. Work holder
e. Workpiece
f. Machinist's Handbook

TASK

MS-92 Performing indexing operations

PERFORMANCE OBJECTIVE

Cut a flute or groove and a helix using the dividing head.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Safety
b. Accuracy required
c. Attachments and cutters
d. Speeds and feeds
e. Determining number of turns of index crank
f. Selecting the index plate
g. Work and vise alignment

Provide Demonstration On:

a. Setting up machine and dividing head
b. Selecting and mounting cutters
c. Making a cut and re-positioning the index using the index fingers

Provide Practical Application On:

a. Identify and classify workpiece material.
b. Mount and align dividing head.
c. Select and mount cutter.

(Continued on back)

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part II
b. Porter
c. Walker
d. Kibbe

A/Vs:

a. Bergwall, filmstrip #502-5, "Milling Machine Explained"
b. Prentice-Hall, filmstrip #VD919-4, "Machine Shop: Horizontal Milling Machine"

Student Manuals:

Ohio, Machine Trades II, Milling Assignment Sheets #19, 20, 21

Tools and Equipment:

a. Milling machine, dividing head and accessories
b. Cutters and attachments
c. Measuring instruments
d. Work holder
e. Workpiece
f. Machinist's Handbook

CLASSROOM HOURS

10

EVALUATION (MS-92)

a. Given a milling machine and necessary tools and equipment, the student will cut a flute and a helix gear. All work must be ± 0.001" to specifications.

b. Ohio, Machine Trades II, Instructor Manual.

c. V'TECS, Machine Shop, Task No. 133.

INSTRUCTIONAL ACTIVITIES

Provide Practical Application On:

d. Mount and align holding device and workpiece.
e. Determine number of indexes that workpiece must be rotated.
f. Set up indexing unit of dividing head.
g. Select and set up speed and feed.
h. Touch off, make primary cut and adjust for depth of cut.
i. Measure for blueprint specifications and make necessary adjustments.
j. Recut if necessary.
k. Rotate indexing unit for each subsequent cut specified.
l. Inspect and measure finished part to blueprint specifications.

TASK

MS-93 Performing circular milling operations

PERFORMANCE OBJECTIVE

Cut a circle segment to specifications.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Safety
b. Accuracy required
c. Attachments and rotary table
d. Speeds and feeds
e. Determining the desired ARC
f. Holding devices
g. Work alignment

Provide Demonstration On:

a. Setting up machine and determining desired ARC
b. Selecting and mounting cutters
c. Making a cut

Provide Practical Application On:

Set up machine and cut a circle segment and a circular slot.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part II
b. Kibbe

A/Vs:

Bergwall, filmstrip #502-3, "Milling Machine Explained"

Student Manuals:

Ohio, Machine Trades II, Milling Assignment Sheet #22

Tools and Equipment:

a. Milling machine and rotary attachment
b. Cutters and attachments
c. Measuring instruments
d. Work holder
e. Workpiece
f. Machinist's Handbook

CLASSROOM HOURS

6

EVALUATION (MS-93)

a. Given a milling machine and necessary tools and equipment, the student will cut a circle segment and a cylindrical slot to a tolerance of ± 0.001.

b. Ohio, Machine Trades II, Instructor Manual.

c. V'TECS, Machine Shop, Task No. 127.

TASK

MS-94 Performing graduating and marking operations

PERFORMANCE OBJECTIVE

Cut witness marks of equal graduation on a flat and a cylindrical surface.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Safety
b. Accuracy required
c. Attachments, scriber tool and arbor, spacers
d. Speeds and feeds
e. Determining graduation degrees
f. Holding devices
g. Work alignment
h. Using the index head and gear train for cylindrical work

Provide Demonstration On:

a. Setting up machine
b. Selecting and mounting cutters
c. Making a cut

Provide Practical Application On:

Set up machine and cut graduation marks on a flat surface and cylindrical surface.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part II
b. Kibbe

A/Vs:

Bergwall, filmstrip #502-5, 6, "Milling Machine Explained"

Student Manuals:

Ohio, Machine Trades II, Milling Assignment Sheet #23

Tools and Equipment:

a. Milling machine
b. Cutters and attachments
c. Measuring instruments
d. Work holder
e. Workpiece
f. Machinist's Handbook

CLASSROOM HOURS 4

EVALUATION (MS-94)

a. Given a milling machine and necessary tools and equipment, the student will cut graduation marks to .001 inches with a tolerance of ± 0.0001.

b. Ohio, Machine Trades II, Instructor Manual.

TASK

MS-95 Performing profiling

PERFORMANCE OBJECTIVE

Cut a sheetmetal template and use for the profiling operation.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Safety
b. Cutting the template
c. Accuracy required
d. Clamping template to workpiece attachments (pantograph)
e. Speeds and feeds
f. Rough and finish cuts holding devices
g. Work alignment
h. Hand and eye coordination

Provide Demonstration On:

a. Setting up machine
b. Cutting template
c. Selecting and mounting cutters
d. Making a cut

Provide Practical Application On:

a. Mount and align holding device.
b. Mount and align pattern-holding device.
c. Mount workpiece and pattern.
d. Select and mount cutter and stylus.

(Continued on back)

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part II
b. Kibbe

Tools and Equipment:

a. Milling machine
b. Cutters and attachments
c. Measuring instruments
d. Work holder
e. Workpiece
f. Machinist's Handbook

CLASSROOM HOURS 8

EVALUATION (MS-95)

a. Given a milling machine and necessary tools and equipment, the student will cut a template to specifications and use the template to profile a workpiece. All work must be to a tolerance of ± 0.005" of profile dimensions.

b. Ohio, Machine Trades II, Instructor Manual.

c. V'TECS, Machine Shop, Task No. 123.

INSTRUCTIONAL ACTIVITIES

Provide Practical Application On:

e. Select and set speed and feed.
f. Duplicate the profile.
g. Measure to determine accuracy.
h. Make adjustments as necessary.

TASK

MS-96 Maintaining and caring for the milling machine

PERFORMANCE OBJECTIVE

Provide daily lubrication, adjustment and major oil change.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Cleaning the machine
b. Lubricating
c. Adjustments
d. Inspection
e. Removing nicks and burrs from machined surfaces

Provide Demonstration On:

Daily maintenance and adjustments

Provide Practical Application On:

Clean and care for the milling machine as it is used.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burghardt, Part II
b. Porter
c. Kibbe

Student Manuals:

a. Georgia, Metal Fabrication Cluster, PLACE Package Title No. HM-11
b. Ohio, Machine Trades II, Milling Assignment Sheet #2

Tools and Equipment:

a. Manufacturer's lubrication chart
b. Hand tools and equipment for lubrication and adjusting machine
c. Brush

CLASSROOM HOURS

3

EVALUATION (MS-96)

a. Given a milling machine, the student will clean, lubricate and adjust it according to manufacturer's specifications.

b. Ohio, Machine Trades II, Instructor Manual.

c. Georgia, Metal Fabrication Cluster, Teachers Edition.

SECTION IV

CURRICULUM STRUCTURE, EXIT POINTS & COURSE OUTLINE

SECTION IV

Section IV Content List

Introduction to the Curriculum Structure
Curriculum Structure
  Group
  Individualized
Introduction to Metals Exit Points
Introduction to the Course Outline
Course Outline

Section III presented a sample organizational model for sequencing the instruction of program tasks. Based on that model, Section IV provides suggested methods of structuring the entire Metals Cluster curriculum.

INTRODUCTION TO THE CURRICULUM STRUCTURE

A curriculum structure is developed by sequencing duties* into a logical teaching plan. Two curriculum structures are presented in this section - group and individualized.

The individualized structure also lists the duty areas under major blocks, but does not include hours or quarters. Using the individualized approach, the student proceeds at his or her pace until each task is mastered.

In either type of structure, the duty areas and major blocks can be rearranged to meet local needs.

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*Duties are large segments of work done by an individual and usually require several tasks to accomplish. They are generally grouped under the major teaching blocks of the program.

METALS CLUSTER SUGGESTED CURRICULUM STRUCTURE

(Alternative 1)

Course Number	Course	Clock Hours
	First Quarter	
	General Metals:	
	Metallurgy	80
	Bench Work	38
		118
	Second Quarter	
	General Metals:	
	Bench Work	62
	Metal Fabrication	65
		127
	Third Quarter	
	General Metals:	
	Metal Fabrication	115
		115
	Fourth Quarter	
	Welding:	
	Foundations	53
	Oxyacetylene Welding, Cutting, Brazing and Soldering	72
		125
	Fifth Quarter	
	Welding:	
	Oxyacetylene Welding, Cutting, Brazing and Soldering	77
	Shielded Arc Welding	40
		117

Course Number	Course	Clock Hours
	Sixth Quarter	
	Welding:	
	Shielded Arc Welding	28
	Inert Gas Welding	90
		118
	Seventh Quarter	
	Machine Shop:	
	Drilling Machine Work	31
	Power Saw Work	27
	Engine Lathe Work	66
		124
	Eighth Quarter	
	Machine Shop:	
	Engine Lathe Work	89
	Milling Machine Work	30
		119
	Ninth Quarter	
	Machine Shop:	
	Milling Machine Work	117
		117

METALS CLUSTER CURRICULUM SUGGESTED STRUCTURE

(Alternative 2)

Course Number	Course	Clock Hours
	First Semester	
	General Metals:	
	Metallurgy	80
	Bench Work	100
		180
	Second Semester	
	Sheet Metal:	
	Metal Fabrication	180
		180
	Third Semester	
	Welding:	
	Foundations	53
	Oxyacetylene Welding, Cutting, Brazing and Soldering	129
		182
	Fourth Semester	
	Welding:	
	Oxyacetylene Welding, Cutting, Brazing and Soldering	20
	Shielded Arc Welding	68
	Inert Gas Welding	90
		178
	Fifth Semester	
	Machine Shop:	
	Drilling Machine Work	31
	Power Saw Work	27
	Engine Lathe Work	122
		180

Course Number	Course	Clock Hours
	Sixth Semester	
	Machine Shop:	
	Engine Lathe Work	33
	Milling Machine Work	147
		180

METALS CLUSTER CURRICULUM STRUCTURE

(Alternative 3)

An organizational chart for grouping
first, second and third year students

GM General Metals
SM Sheet Metal
WL Welding
MS Machine Shop

Students entering the Metals Cluster should begin training as first year students, regardless of class standing.

First Year Students (total - 8)

Number of students in each category

1st 9 wks	GM -2	SM -2	WL -2	MS -2
2nd 9 wks	SM -2	WL -2	MS -2	GM -2
3rd 9 wks	WL -2	MS -2	GM -2	SM -2
4th 9 wks	MS -2	GM -2	SM -2	WL -2

Second Year Students (total - 6)

Number of students in each category

1st half year	GM -1	MS -1	SM -1	WL -1	GM -1	SM -1
2nd half year	SM -1	WL -1	MS -1	GM -1	MS -1	WL -1

Third Year Students (total - 4)

Number of students in each category

Entire Year	SM -1	MS -1	WL -1	GM -1

Total number of students - 18

This structure shows how first, second and third year students may be grouped in a single two-hour block. The instructor would have three two-hour blocks similar to this each day.

METALS CLUSTER SUGGESTED CURRICULUM STRUCTURE*

ORIENTATION:
- School Policies and Procedures
- Program Orientation and Safety
- Operation of Audiovisual Equipment
- Using the Learning Resource Center

GENERAL METALS:
- Metallurgy
- Bench Work
- Metal Fabrication

WELDING:
- Foundations
- Oxyacetylene Welding, Cutting, Brazing and Soldering
- Shielded Arc Welding
- Inert Gas Welding

MACHINE SHOP:
- Drilling Machine Work
- Power Saw Work
- Engine Lathe Work
- Milling Machine Work

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*This curriculum structure is designed to be used for individualized instruction in the Quarter system.

METALS CLUSTER SUGGESTED CURRICULUM STRUCTURE*

ORIENTATION:
- School Policies and Procedures
- Program Orientation and Safety
- Operation of Audiovisual Equipment
- Using the Learning Resource Center

GENERAL METALS:
- Metallurgy
- Bench Work
- Metal Fabrication

WELDING:
- Foundations
- Oxyacetylene Welding, Cutting, Brazing and Soldering
- Shielded Arc Welding
- Inert Gas Welding

MACHINE SHOP:
- Drilling Machine Work
- Power Saw Work
- Engine Lathe Work
- Milling Machine Work

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*This curriculum structure is designed to be used for individualized instruction in the Semester system.

INTRODUCTION TO METALS CLUSTER
EXIT POINTS

The following diagrams illustrate points in the Metals Cluster program where a student should have acquired competencies necessary for entry level employment.

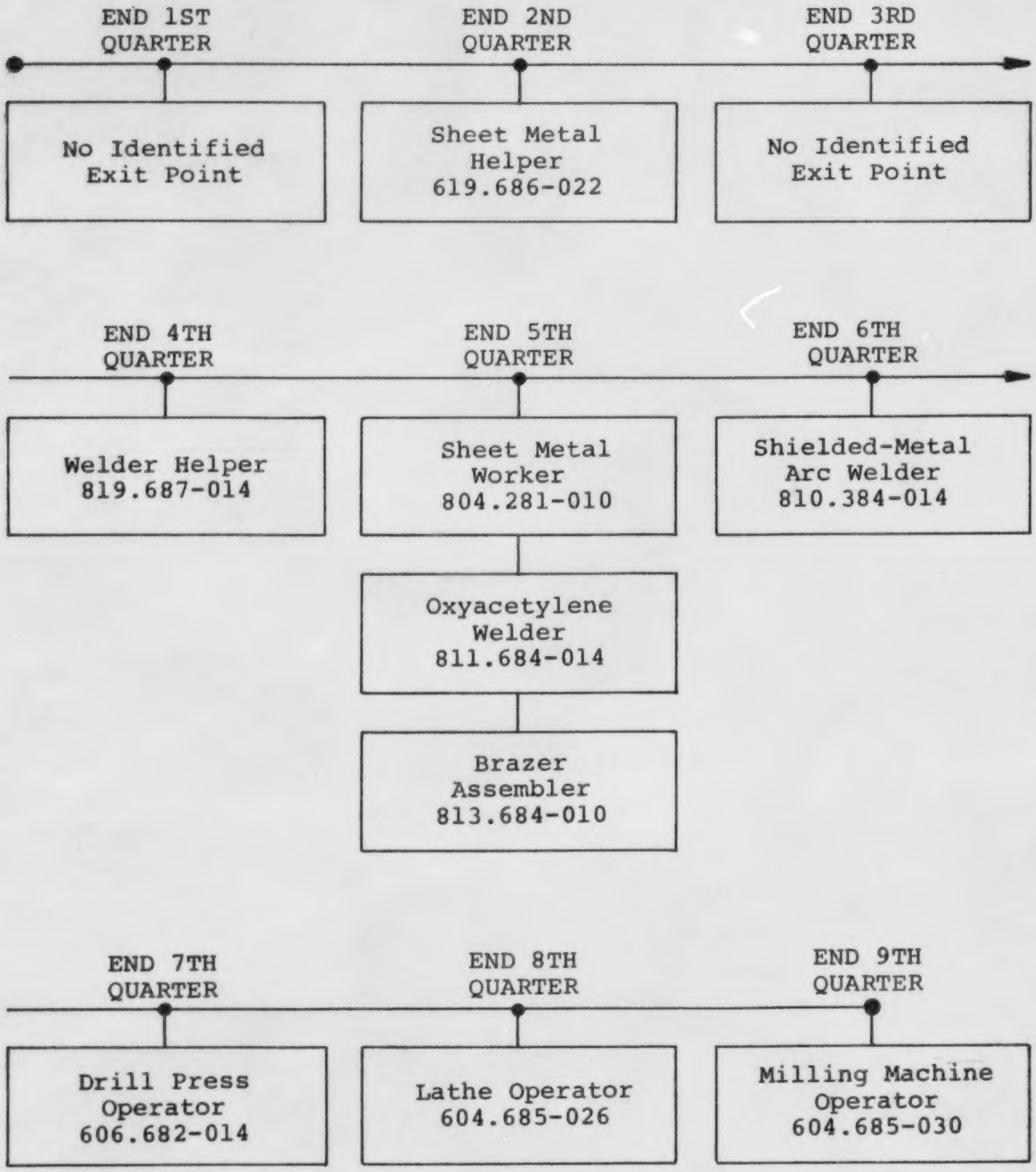
Both the group and individualized exit point diagrams sequence the Metals Cluster job classifications from least to most difficult. The group exit point diagram illustrates a lock-step process in which students proceed through an entire program at the same pace and exit at approximately the same point in time.

The individualized exit point diagram illustrates a self-paced progression through the Metals Cluster program. This approach permits a student to complete any one or all tasks necessary for entry level employment.

The major difference between the group and individualized approach is the number of tasks a student must master. For example, in the individualized approach, a student desiring employment as a Sheet Metal Helper needs to complete only those tasks identified for that job. However, in the group approach, a student must master the tasks in the previous DOT classifications leading to that particular job title.

The diagrams are based on the preceeding suggested curriculum structures.

METALS CLUSTER
(GROUP INSTRUCTION)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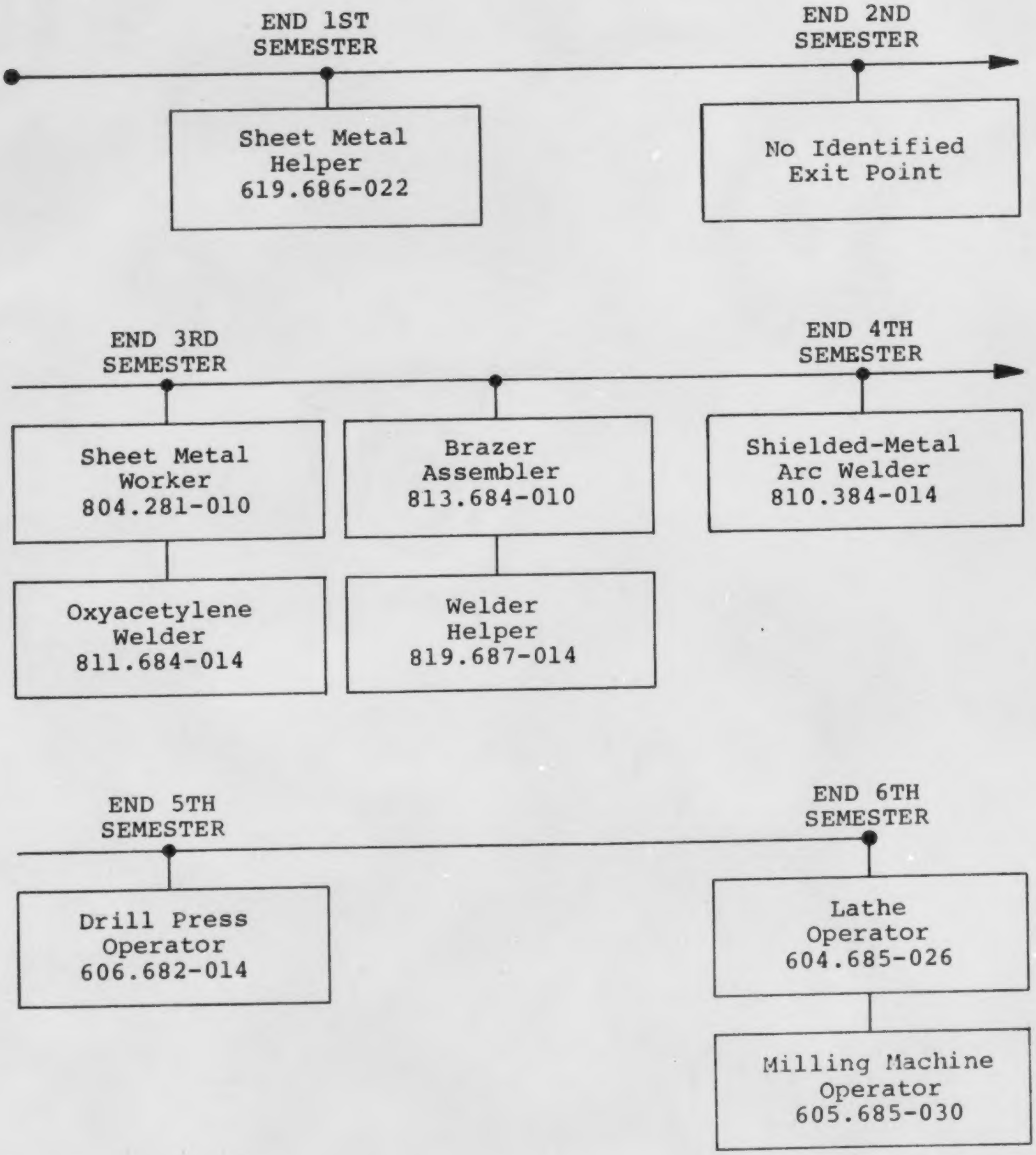
No Identified Exit Point
END 2ND QUARTER
Sheet Metal Helper 619.686-022
END 3RD QUARTER
No Identified Exit Point
END 4TH QUARTER
Welder Helper 819.687-014
END 5TH QUARTER
Sheet Metal Worker 804.281-010
Oxyacetylene Welder 811.684-014
Brazer Assembler 813.684-010
END 6TH QUARTER
Shielded-Metal Arc Welder 810.384-014
END 7TH QUARTER
Drill Press Operator 606.682-014
END 8TH QUARTER
Lathe Operator 604.685-026
END 9TH QUARTER
Milling Machine Operator 604.685-030

METALS CLUSTER
(GROUP INSTRUCTION)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END 2ND SEMESTER
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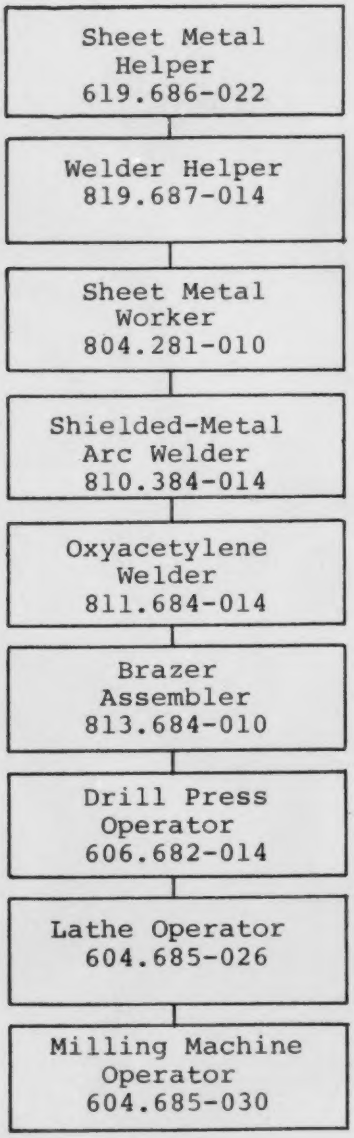
No Identified Exit Point
END 3RD SEMESTER
END 4TH SEMESTER
Sheet Metal Worker 804.281-010
Brazer Assembler 813.684-010
Shielded-Metal Arc Welder 810.384-014
Oxyacetylene Welder 811.684-014
Welder Helper 819.687-014
END 5TH SEMESTER
END 6TH SEMESTER
Drill Press Operator 606.682-014
Lathe Operator 604.685-026
Milling Machine Operator 605.685-030

METALS CLUSTER
(INDIVIDUALIZED INSTRUCTION)


Sheet Metal Helper 619.686-022
Welder Helper 819.687-014
Sheet Metal Worker 804.281-010
Shielded-Metal Arc Welder 810.384-014
Oxyacetylene Welder 811.684-014
Brazer Assembler 813.684-010
Drill Press Operator 606.682-014
Lathe Operator 604.685-026
Milling Machine Operator 604.685-030

INTRODUCTION TO THE COURSE OUTLINE

A course outline suggests a method of sequencing tasks for instruction. In the following outline, the unit guide tasks are ordered according to duty areas. The tasks are then arranged from general to specific knowledge and applications. The instructor is not restricted to using this specific outline, but may adapt it to meet his or her teaching needs.

The following course outline is designed for group instruction, however, it may be adapted for individualized instruction by eliminating the time sequencing for tasks.

METALS CLUSTER SUGGESTED COURSE OUTLINE

Quarter I

Unit/Task	Title	Classroom & Lab Hours
	MAJOR BLOCK: GENERAL METALS	
	Duty A: Metallurgy	
GM-01	Identifying metal manufacturing processes	5
GM-02	Identifying the physical structure of metals	5
GM-03	Identifying properties of metals	10
GM-04	Identifying methods of heat treatment	10
GM-05	Identifying iron manufacturing processes	10
GM-06	Identifying processes used to produce steel	10
GM-07	Identifying processes used to produce copper, brass and bronze alloys	10
GM-08	Identifying processes used to produce aluminum	10
GM-09	Identifying processes for the production of magnesium and titanium	10
		80
	Duty B: Bench Work	
GM-10	Laying out metal surfaces	12
GM-11	Identifying jig buttons	4
GM-12	Using the sine bar	4
GM-13	Using the bevel protractor	4
GM-14	Using steel rules	2
GM-15	Using the micrometer	4
GM-16	Reading a vernier scale	4
GM-17	Using dial indicators, center testers and speed indicators	4
		38
	Total Quarter I Hours:	118

Quarter II

Unit/Task	Title	Classroom & Lab Hours
	MAJOR BLOCK: GENERAL METALS	
	Duty B: Bench Work	
GM-18	Using precision gage blocks, tapered ring, plug and snap gages	4
GM-19	Identifying and using hand hacksaws	4
GM-20	Using abrasives and lapping compounds	4
GM-21	Identifying and using files	4
GM-22	Scraping flat and curved bearing surfaces	2
GM-23	Using hammers and screwdrivers for hand bench use	4
GM-24	Identifying and using wrenches	4
GM-25	Using bench vices and clamps	4
GM-26	Identifying and using chipping tools	4
GM-27	Using hand taps, dies and hand reamers	4
GM-28	Identifying power tool safety practices	2
GM-29	Assembling and fitting	4
GM-30	Identifying fasteners	4
GM-31	Using thread, center, fillet and radius gages	4
GM-32	Identifying lubricants and greases	4
GM-33	Performing machine maintenance	4
GM-34	Identifying bench work safety	2
		62
	Duty C: Metal Fabrication	
SM-01	Identifying materials used in sheet metalwork	10
SM-02	Developing sheet metal patterns (stretchouts)	15
SM-03	Cutting sheet metal	20
SM-04	Bending sheet metal by hand	20
		65
	Total Quarter II Hours:	127

Quarter III

Unit/Task	Title	Classroom & Lab Hours
	MAJOR BLOCK: GENERAL METALS	
	Duty C: Metal Fabrication	
SM-05	Bending metal on a bar folder or brake	10
SM-06	Roll-forming sheet metal	25
SM-07	Making seams	30
SM-08	Using the rotary machine	20
SM-09	Fastening sheet metal	20
SM-10	Soft soldering sheet metal	10
		115

Total Quarter III Hours: 115

Quarter IV

Unit/Task	Title	Classroom & Lab Hours
	MAJOR BLOCK: WELDING	
	Duty D: Foundations	
WL-01	Practicing safety	5
WL-02	Identifying and using welding symbols	8
WL-03	Using welding related shop tools and equipment	10
WL-04	Identifying and preparing metals for welding	10
WL-05	Measuring welding materials	5
WL-06	Using clamps and jigs	5
WL-07	Reading blueprints	10
		53
	Duty E: Oxyacetylene Welding, Cutting, Brazing and Soldering	
WL-08	Following safety procedures and regulations for oxyacetylene welding	4
WL-09	Using oxyacetylene cylinders and gases	7
WL-10	Inspecting oxygen and acetylene regulators	7
WL-11	Selecting and maintaining oxyacetylene torches and tips	4
WL-12	Setting up and lighting the oxyacetylene torch	4
WL-13	Carrying a puddle without a filler rod	6
WL-14	Welding an outside corner joint without a filler rod using oxyacetylene equipment	10
WL-15	Making beads with filler rods using oxyacetylene equipment	10
WL-16	Welding butt joints using oxyacetylene equipment	10
WL-17	Welding lap joints using oxyacetylene equipment	10
		72
	Total Quarter IV Hours:	125

Quarter V

Unit/Task	Title	Classroom & Lab Hours
	MAJOR BLOCK: WELDING	
	Duty E: Oxyacetylene Welding, Cutting, Brazing and Soldering	
WL-18	Welding T-joints using oxyacetylene equipment	10
WL-19	Setting up the oxyacetylene apparatus for flame cutting	5
WL-20	Cutting with an oxyacetylene cutting torch	10
WL-21	Piercing and cutting holes using the oxyacetylene cutting torch	10
WL-22	Cutting with an automatic oxyacetylene cutting machine	8
WL-23	Welding beads with brass rods using oxyacetylene welding equipment	4
WL-24	Brazing a lap joint using oxyacetylene apparatus	5
WL-25	Brazing with silver using oxyacetylene equipment	5
WL-26	Soldering	5
WL-27	Welding cast iron using oxyacetylene apparatus	10
WL-28	Cutting and welding pipe using oxyacetylene apparatus	5
		77
	Duty F: Shielded Arc Welding	
WL-29	Selecting and setting up shielded arc welding appartus	10
WL-30	Welding string and weave beads using shielded arc welding appratus	10
WL-31	Arc welding string beads and padding a plate	10
WL-32	Arc welding lap joints	10
		40
	Total Quarter V Hours:	117

Quarter VI

Unit/Task	Title	Classroom & Lab Hours
	MAJOR BLOCK: WELDING	
	Duty F: Shielded Arc Welding	
WL-33	Arc welding butt joints	10
WL-34	Shielded arc welding T-fillet joints	10
WL-35	Testing arc welded joints	8
		28
	Duty G: Inert Gas Welding	
WL-36	Identifying and describing tungsten inert gas welding processes	7
WL-37	Following safety procedures and regulations for TIG welding	4
WL-38	Identifying TIG welding equipment	3
WL-39	Setting up TIG equipment to weld aluminum	7
WL-40	Identifying and describing metal inert gas (MIG) welding processes	10
WL-41	MIG welding beads on mild steel plate	15
WL-42	MIG welding butt joints using mild steel plate	10
WL-43	MIG welding lap joints using mild steel plate	10
WL-44	MIG welding fillet joints using mild steel plate	8
WL-45	MIG welding with stainless steel	8
WL-46	MIG welding with aluminum	8
		90
	Total Quarter VI Hours:	118

Quarter VII

Unit/Task	Title	Classroom & Lab Hours
	MAJOR BLOCK: MACHINE SHOP	
	Duty H: Drilling Machine Work	
MS-01	Identifying parts and functions of the drilling machine	2
MS-02	Identifying safety practices and precautions when using the drilling machine	2
MS-03	Identifying work holding devices and set ups	2
MS-04	Identifying and using drill bit holding devices	2
MS-05	Identifying drill bits	1
MS-06	Identifying cutting feeds and speeds	2
MS-07	Identifying principles of straight drilling	2
MS-08	Identifying and using coolants and cutting compounds	2
MS-09	Grinding and care of drills	2
MS-10	Identifying and using twist drill gages	2
MS-11	Identifying and using drill grinding machines	1
MS-12	Identifying machine reamers	2
MS-13	Machine reaming	1
MS-14	Identifying principles of boring and counterboring	2
MS-15	Spot facing	2
MS-16	Countersinking, center drilling and tapping	4
		31
	Duty I: Power Saw Work	
MS-17	Identifying power cut-off saws	2
MS-18	Identifying power saw safety	1
MS-19	Identifying and using work holding devices on the power cut-off saw	4
MS-20	Identifying, selecting, mounting and maintaining saw blades	4
MS-21	Identifying speeds, feeds and coolants for power cut-off saw	2
MS-22	Using the power cut-off saw for straight and angular sawing	4
MS-23	Identifying the metal band saw	2
MS-24	Identifying coolants and lubricating agents for band saws	2
MS-25	Choosing saw blades for the metal band saw	2

Unit/Task	Title	Classroom & Lab Hours
MS-26	Calculating feeds and speeds for the metal band saw	4
		27
	Duty J: Engine Lathe Work	
MS-27	Identifying lathe safety	2
MS-28	Identifying lathes	2
MS-29	Identifying work holding devices	2
MS-30	Identifying cutting tools	2
MS-31	Identifying measuring tools	2
MS-32	Identifying lathe attachments	2
MS-33	Calculating cutting feeds and speeds on the lathe	3
MS-34	Determining RPM	2
MS-35	Centering stock	2
MS-36	Identifying principles of facing	2
MS-37	Identifying principles of straight turning and turning to shoulders	4
MS-38	Identifying checks	2
MS-39	Form turning	6
MS-40	Identifying faceplate work	3
MS-41	Using draw-in collets	4
MS-42	Identifying principles of drilling	2
MS-43	Identifying machine reamers	2
MS-44	Reaming on the engine lathe	4
MS-45	Boring on the engine lathe	4
MS-46	Identifying and using mandrels	2
MS-47	Knurling on the engine lathe	6
MS-48	Cutting off on the engine lathe	6
		66

Total Quarter VII Hours: 124

Quarter VIII

Unit/Task	Title	Classroom & Lab Hours
	MAJOR BLOCK: MACHINE SHOP	
	Duty J: Engine Lathe Work	
MS-49	Identifying thread cutting devices	2
MS-50	Identifying the parts of a thread	2
MS-51	Identifying American National Thread standards	2
MS-52	Computing American National Thread form	2
MS-53	Computing sharp V-thread formulas	2
MS-54	Identifying Acme threads	2
MS-55	Using the Acme tap	4
MS-56	Identifying square threads	2
MS-57	Identifying classes of fits of screw threads	2
MS-58	Using thread gages	4
MS-59	Using a thread micrometer	4
MS-60	Measuring threads with the three-wire method	2
MS-61	Cutting threads with an even geared lathe	4
MS-62	Cutting threads on a lathe which is not even geared	4
MS-63	Cutting threads on a quick-change gear lathe	4
MS-64	Identifying multiple lead screw threads	2
MS-65	Cutting left hand threads	4
MS-66	Determining a tap drill size	2
MS-67	Cutting interval threads and tapping	6
MS-68	Identifying principles of taper turning	5
MS-69	Computing tapers	1
MS-70	Measuring short tapers	5
MS-71	Gaging inside and outside tapers	4
MS-72	Tapering by the offset tail stock methods	2
MS-73	Cutting a taper with the compound rest	4
MS-74	Cutting a taper with the taper attachment	4
MS-75	Boring or turning interval tapers	4
MS-76	Identifying coolants and cutting compounds	2
MS-77	Identifying lubricants	2
		89
	Duty K: Milling Machine Work	
MS-78	Identifying types, sizes, construction, specifications, nomenclature and range of work for milling machines	5

Unit/Task	Title	Classroom & Lab Hours
MS-79	Identifying milling machine work holding devices and their functions	3
MS-80	Identifying, selecting and aligning milling machine attachments	8
MS-81	Selecting and setting up milling machine cutters and holders	10
MS-82	Calculating cutting speeds and feeds for milling machine work	4
		30

Total Quarter VIII Hours: 119

Quarter IX

MAJOR BLOCK: MACHINE SHOP

Duty I: Milling Machine Work

Unit/Task	Title	Classroom & Lab Hours
MS-83	Performing a plain milling operation	10
MS-84	Performing a face milling operation	10
MS-85	Performing a side milling operation	10
MS-86	Performing a form milling operation	10
MS-87	Performing an angular milling operation	10
MS-88	Performing an end milling operation	10
MS-89	Drilling, boring and reaming with the milling machine	10
MS-90	Performing sawing, slitting and cutting off operations with the milling machine	6
MS-91	Performing keyseating and T-slot milling operations	10
MS-92	Performing indexing operations	10
MS-93	Performing circular milling operations	6
MS-94	Performing graduating and marking operations	4
MS-95	Performing profiling	8
MS-96	Maintaining and caring for the milling machine	3
		117

Total Quarter IX Hours: 117

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METALS CLUSTER SUGGESTED COURSE OUTLINE

Semester I

Unit/Task	Title	Classroom & Lab Hours
	MAJOR BLOCK: GENERAL METALS	
	Duty A: Metallurgy	
GM-01	Identifying metal manufacturing processes	5
GM-02	Identifying the physical structure of metals	5
GM-03	Identifying properties of metals	10
GM-04	Identifying methods of heat treatment	10
GM-05	Identifying iron manufacturing processes	10
GM-06	Identifying processes used to produce steel	10
GM-07	Identifying processes used to produce copper, brass and bronze alloys	10
GM-08	Identifying processes used to produce aluminum	10
GM-09	Identifying processes for the production of magnesium and titanium	10
		80
	Duty B: Bench Work	
GM-10	Laying out metal surfaces	12
GM-11	Identifying jig buttons	4
GM-12	Using the sine bar	4
GM-13	Using the bevel protractor	4
GM-14	Using steel rules	2
GM-15	Using the micrometer	4
GM-16	Reading a vernier scale	4
GM-17	Using dial indicators, center testers and speed indicators	4
GM-18	Using precision gage blocks, tapered ring, plug and snap gages	4
GM-19	Identifying and using hand hacksaws	4
GM-20	Using abrasives and lapping compounds	4
GM-21	Identifying and using files	4
GM-22	Scraping flat and curved bearing surfaces	2
GM-23	Using hammers and screwdrivers for hand bench use	4
GM-24	Identifying and using wrenches	4
GM-25	Using bench vices and clamps	4
GM-26	Identifying and using chipping tools	4
GM-27	Using hand taps, dies and hand reamers	4
GM-28	Identifying power tool safety practices	2
GM-29	Assembling and fitting	4

Unit/Task	**Title**	**Classroom & Lab Hours**
GM-30	Identifying fasteners	4
GM-31	Using thread, center, fillet and radius gages	4
GM-32	Identifying lubricants and greases	4
GM-33	Performing machine maintenance	4
GM-34	Identifying bench work safety	2
		100

Total Semester I Hours: 180

Semester II

MAJOR BLOCK: SHEET METAL

Duty C: Metal Fabrication

Unit/Task	Title	Classroom & Lab Hours
SM-01	Identifying materials used in sheet metalwork	10
SM-02	Developing sheetmetal patterns (stretchouts)	15
SM-03	Cutting sheet metal	20
SM-04	Bending sheet metal by hand	20
SM-05	Bending metal on a bar folder or brake	10
SM-06	Roll-forming sheet metal	25
SM-07	Making seams	30
SM-08	Using the rotary machine	20
SM-09	Fastening sheet metal	20
SM-10	Soft soldering sheet metal	10
		180

Total Semester II Hours: 180

Semester III

Unit/Task	Title	Classroom & Lab Hours
	MAJOR BLOCK: WELDING	
	Duty D: Foundations	
WL-01	Practicing safety	5
WL-02	Identifying and using welding symbols	8
WL-03	Using welding related shop tools and equipment	10
WL-04	Identifying and preparing metals for welding	10
WL-05	Measuring welding materials	5
WL-06	Using clamps and jigs	5
WL-07	Reading blueprints	10
		53
	Duty E: Oxyacetylene Welding, Cutting, Brazing and Soldering	
WL-08	Following safety procedures and regulations for oxyacetylene welding	4
WL-09	Using oxyacetylene cylinders and gases	7
WL-10	Inspecting oxygen and acetylene regulators	7
WL-11	Selecting and maintaining oxyacetylene torches and tips	4
WL-12	Setting up and lighting the oxyacetylene torch	4
WL-13	Carrying a puddle without a filler rod	6
WL-14	Welding an outside corner joint without a filler rod using oxyacetylene equipment	10
WL-15	Making beads with filler rods using oxyacetylene equipment	10
WL-16	Welding butt joints using oxyacetylene equipment	10
WL-17	Welding lap joints using oxyacetylene equipment	10
WL-18	Welding T-joints using oxyacetylene equipment	10
WL-19	Setting up the oxyacetylene apparatus for flame cutting	5
WL-20	Cutting with an oxyacetylene cutting torch	10
WL-21	Piercing and cutting holes using the oxyacetylene cutting torch	10
WL-22	Cutting with an automatic oxyacetylene cutting machine	8

Unit/Task	Title	Classroom & Lab Hours
WL-23	Welding beads with brass rods using oxyacetylene welding equipment	4
WL-24	Brazing a lap joint using oxyacetylene apparatus	5
WL-25	Brazing with silver using oxyacetylene equipment	5
		129
	Total Semester III Hours:	182

469

Semester IV

Unit/Task	Title	Classroom & Lab Hours
	MAJOR BLOCK: WELDING	
	Duty E: Oxyacetylene Welding, Cutting, Brazing and Soldering	
WL-26	Soldering	5
WL-27	Welding cast iron using oxyacetylene apparatus	10
WL-28	Cutting and welding pipe using oxyacetylene apparatus	5
		20
	Duty F: Shielded Arc Welding	
WL-29	Selecting and setting up shielded arc welding apparatus	10
WL-30	Welding string and weave beads using shielded arc welding apparatus	10
WL-31	Arc welding string beads and padding a plate	10
WL-32	Arc welding lap joints	10
WL-33	Arc welding butt joints	10
WL-34	Shielded arc welding T-fillet joints	10
WL-35	Testing arc welded joints	8
		68
	Duty G: Inert Gas Welding	
WL-36	Identifying and describing tungsten inert gas welding processes	7
WL-37	Following safety procedures and regulations for TIG welding	4
WL-38	Identifying TIG welding equipment	3
WL-39	Setting up TIG equipment to weld aluminum	7
WL-40	Identifying and describing metal inert gas (MIG) welding processes	10
WL-41	MIG welding beads on mild steel plate	15
WL-42	MIG welding butt joints using mild steel plate	10
WL-43	MIG welding lap joints using mild steel plate	10
WL-44	MIG welding fillet joints using mild steel plate	8
WL-45	MIG welding with stainless steel	8
WL-46	MIG welding with aluminum	8
		90
	Total Semester IV Hours:	178

Semester V

Unit/Task	Title	Classroom & Lab Hours
	MAJOR BLOCK: MACHINE SHOP	
	Duty H: Drilling Machine Work	
MS-01	Identifying parts and functions of the drilling machine	2
MS-02	Identifying safety practices and precautions when using the drilling machine	2
MS-03	Identifying work holding devices and set ups	2
MS-04	Identifying and using drill bit holding devices	2
MS-05	Identifying drill bits	1
MS-06	Identifying cutting feeds and speeds	2
MS-07	Identifying principles of straight drilling	2
MS-08	Identifying and using coolants and cutting compounds	2
MS-09	Grinding and care of drills	2
MS-10	Identifying and using twist drill gages	2
MS-11	Identifying and using drill grinding machines	1
MS-12	Identifying machine reamers	2
MS-13	Machine reaming	1
MS-14	Identifying principles of boring and counterboring	2
MS-15	Spot facing	2
MS-16	Countersinking, center drilling and tapping	4
		31
	Duty I: Power Saw Work	
MS-17	Identifying power cut-off saws	2
MS-18	Identifying power saw safety	1
MS-19	Identifying and using work holding devices on the power cut-off saw	4
MS-20	Identifying, selecting, mounting and maintaining saw blades	4
MS-21	Identifying speeds, feeds and coolants for power cut-off saws	2
MS-22	Using the power cut-off saw for straight and angular sawing	4
MS-23	Identifying the metal band saw	2
MS-24	Identifying coolants and lubricating agents for band saws	2
MS-25	Choosing saw blades for the metal band saw	2

Unit/Task	Title	Classroom & Lab Hours
MS-26	Calculating feeds and speeds for the metal band saw	4
		27
	Duty J: Engine Lathe Work	
MS-27	Identifying lathe safety	2
MS-28	Identifying lathes	2
MS-29	Identifying work holding devices	2
MS-30	Identifying cutting tools	2
MS-31	Identifying measuring tools	2
MS-32	Identifying lathe attachments	2
MS-33	Calculating cutting feeds and speeds on the lathe	3
MS-34	Determining RPM	2
MS-35	Centering stock	2
MS-36	Identifying principles of facing	2
MS-37	Identifying principles of straight turning and turning to shoulders	4
MS-38	Identifying checks	2
MS-39	Form turning	6
MS-40	Identifying faceplate work	3
MS-41	Using draw-in collets	4
MS-42	Identifying principles of drilling	2
MS-43	Identifying machine reamers	2
MS-44	Reaming on the engine lathe	4
MS-45	Boring on the engine lathe	4
MS-46	Identifying and using mandrels	2
MS-47	Knurling on the engine lathe	6
MS-48	Cutting off on the engine lathe	6
MS-49	Identifying thread cutting devices	2
MS-50	Identifying the parts of a thread	2
MS-51	Identifying American National Thread standards	2
MS-52	Computing American National Thread form	2
MS-53	Computing sharp V-thread formulas	2
MS-54	Identifying Acme threads	2
MS-55	Using the Acme tap	4
MS-56	Identifying square threads	2
MS-57	Identifying classes of fits of screw threads	2
MS-58	Using thread gages	4
MS-59	Using a thread micrometer	4
MS-60	Measuring threads with the three-wire method	2
MS-61	Cutting threads with an even geared lathe	4
MS-62	Cutting threads on a lathe which is not even geared	4
MS-63	Cutting threads on a quick-change gear lathe	4

Unit/Task	Title	Classroom & Lab Hours
MS-64	Identifying multiple lead screw threads	2
MS-65	Cutting left hand threads	4
MS-66	Determining a tap drill size	2
MS-67	Cutting interval threads and tapping	6
		122
	Total Semester V Hours:	180

Semester VI

Unit/Task	Title	Classroom & Lab Hours
	MAJOR BLOCK: MACHINE SHOP	
	Duty J: Engine Lathe Work	
MS-68	Identifying principles of taper turning	5
MS-69	Computing tapers	1
MS-70	Measuring short tapers	5
MS-71	Gaging inside and outside tapers	4
MS-72	Tapering by the offset tail stock methods	2
MS-73	Cutting a taper with the compound test	4
MS-74	Cutting a taper with the taper attachment	4
MS-75	Boring or turning interval tapers	4
MS-76	Identifying coolants and cutting compounds	2
MS-77	Identifying lubricants	2
		33
	Duty K: Milling Machine Work	
MS-78	Identifying types, sizes, construction, specifications, nomenclature and range of work for milling machines	5
MS-79	Identifying milling machine work holding devices and their functions	3
MS-80	Identifying, selecting and aligning milling machine attachments	8
MS-81	Selecting and setting up milling machine cutters and holders	10
MS-82	Calculating cutting speeds and feeds for milling machine work	4
MS-83	Performing a plain milling operation	10
MS-84	Performing a face milling operation	10
MS-85	Performing a side milling operation	10
MS-86	Performing a form milling operation	10
MS-87	Performing an angular milling operation	10
MS-88	Performing an end milling operation	10
MS-89	Drilling, boring and reaming with the milling machine	10
MS-90	Performing sawing, slitting and cutting off operations with the milling machine	6
MS-91	Performing keyseating and T-slot milling operations	10
MS-92	Performing indexing operations	10
MS-93	Performing circular milling operations	6

Unit/Task	Title	Classroom & Lab Hours
MS-94	Performing graduating and marking operations	4
MS-95	Performing profiling	8
MS-96	Maintaining and caring for the milling machine	3
		147
	Total Semester VI Hours:	180

SECTION V

RECORDS

SECTION V

Section V Content List

Individualized Competency Record
Group Progress Chart

Section V presents suggested ways of recording and documenting the progress of students through the curriculum. The recommended procedures include options for both individual and group records. The very important function of communicating the student's qualifications to potential employers is handled clearly and efficiently by the use of the Certificate of Competency, which is also described in this section.

RECORDS MANAGEMENT

This guide provides a series of easy to use documents that will aid the instructor in recordkeeping and that will be beneficial to the student in entering the work force.

In addition to providing the instructor with an "at a glance" assessment of individual and/or group progress, a Certificate of Competency, which can be used by students seeking employment, is included.

The group progress chart reflects individual task completion of all students. Due to confidentiality of records, grades must not be recorded on the chart. A notation indicating task completion (i.e., x or check) should be used.

INSTRUCTIONS

Instructions

Competency Checklist

1) Enter the student's name.
2) Enter the date and instructor's initials as each unit of instruction is completed.

The Competency Checklist automatically indicates when all the requirements for each DOT exit point or job title have been completed by the student. At each point on the certificate where an asterisk appears, the student is eligible to receive a Certificate of Competency.

Certificate of Competency

A Certificate of Competency is to be issued for each job title for which a student is qualified.

1) Enter the student's name.
2) Enter the school's name
3) Sign and date the form.

A Certificate of Competency may be issued at the time a student qualifies for it, or all certificates for which a student qualifies may be issued to the student when he/she completes or leaves the program.

Group Progress Chart

1) Enter all program tasks across top of matrix.
2) Enter the students' names down the left hand side of matrix.
3) As each student completes a task, a notation should be made in the square which corresponds with the task and the student's name.

COMPETENCY CHECKLIST

PROGRAM: METALS CLUSTER

STUDENT NAME: ______________________________

EXIT POINTS

TASK NO.	UNIT COMPETENCIES	DATE	IN'T.	JOB TITLE	Lathe Operator	Sheet Metal Helper	Milling Machine Operator	Drill Press Operator	Sheet Metal Worker	Shielded-Metal Arc Welder	Oxyacetylene Welder	Brazer Assembler	Welder Helper
				DOT NO.	604.685-026	619.686-022	605.685-030	606.682-014	804.281-010	810.384-014	811.684-014	813.684-010	819.687-014
	Metallurgy												
GM-01	Identifying metal manufacturing processes				X	X	X	X	X	X	X	X	X
GM-02	Identifying the physical structure of metals				X	X	X	X	X	X	X	X	X
GM-03	Identifying properties of metals				X	X	X	X	X	X	X	X	X
GM-04	Identifying methods of heat treatment				X	X	X	X	X	X	X	X	X
GM-05	Identifying iron manufacturing processes				X	X	X	X	X	X	X	X	X
GM-06	Identifying processes used to produce steel				X	X	X	X	X	X	X	X	X
GM-07	Identifying processes used to produce copper, brass and bronze alloys				X	X	X	X	X	X	X	X	X
GM-08	Identifying processes used to produce aluminum				X	X	X	X	X	X	X	X	X
GM-09	Identifying processes for the production of magnesium and titanium				X	X	X	X	X	X	X	X	X
	Bench Work												
GM-10	Laying out metal surfaces				X	X	X	X	X	X	X	X	X
GM-11	Identifying jig buttons				X	X	X	X	X	X	X	X	X
GM-12	Using the sine bar				X	X	X	X	X	X	X	X	X
GM-13	Using the bevel protractor				X	X	X	X	X	X	X	X	X
GM-14	Using steel rules				X	X	X	X	X	X	X	X	X
GM-15	Using the micrometer				X	X	X	X	X	X	X	X	X
GM-16	Reading a vernier scale				X	X	X	X	X	X	X	X	X
GM-17	Using dial indicators, center testers and speed indicators				X	X	X	X	X	X	X	X	X
GM-18	Using precision gage blocks, tapered ring, plug and snap gages				X	X	X	X	X	X	X	X	X
GM-19	Identifying and using hand hacksaws				X	X	X	X	X	X	X	X	X
GM-20	Using abrasives and lapping compounds				X	X	X	X	X	X	X	X	X
GM-21	Identifying and using files				X	X	X	X	X	X	X	X	X
GM-22	Scraping flat and curved bearing surfaces				X	X	X	X	X	X	X	X	X
GM-23	Using hammers and screwdrivers for hand bench use				X	X	X	X	X	X	X	X	X
GM-24	Identifying and using wrenches				X	X	X	X	X	X	X	X	X
GM-25	Using bench vises and clamps				X	X	X	X	X	X	X	X	X
GM-26	Identifying and using chipping tools				X	X	X	X	X	X	X	X	X
GM-27	Using hand taps, dies and hand reamers				X	X	X	X	X	X	X	X	X
GM-28	Identifying power tool safety practices				X	X	X	X	X	X	X	X	X
GM-29	Assembling and fitting				X	X	X	X	X	X	X	X	X
GM-30	Identifying fasteners				X	X	X	X	X	X	X	X	X
GM-31	Using thread, center, fillet and radius gages				X	X	X	X	X	X	X	X	X
GM-32	Identifying lubricants and greases				X	X	X	X	X	X	X	X	X
GM-33	Performing machine maintenance				X	X	X	X	X	X	X	X	X
GM-34	Identifying bench work safety				X	X	X	X	X	X	X	X	X
	Metal Fabrication												
SM-01	Identifying materials used in sheet metalwork					X			X				
SM-02	Developing sheet metal patterns (stretchouts)								X				
SM-03	Cutting sheet metal					X*			X				
SM-04	Bending sheet metal by hand								X				
SM-05	Bending metal on a bar folder or brake								X				
SM-06	Roll-forming sheet metal								X				
SM-07	Making seams								X				

COMPETENCY CHECKLIST

PROGRAM: METALS CLUSTER

STUDENT NAME: ______________________________

EXIT POINTS

TASK NO.	UNIT COMPETENCIES	DATE	IN'T.	DOT NO. / JOB TITLE	604.685-026 Lathe Operator	619.686-022 Sheet Metal Helper	605.685-030 Milling Machine Operator	606.682-014 Drill Press Operator	804.281-010 Sheet Metal Worker	810.384-014 Shielded-Metal Arc Welder	811.684-014 Oxyacetylene Welder	813.684-0'0 Brazer Assembler	819.667-014 Welder Helper
SM-08	Using the rotary machine								X				
SM-09	Fastening sheet metal								X				
SM-10	Soft soldering sheet metal								X				
	Foundations												
WL-01	Practicing safety								X	X	X	X	
WL-02	Identifying and using welding symbols								X	X	X	X	
WL-03	Using welding related shop tools and equipment								X	X	X	X	
WL-04	Identifying and preparing metals for welding								X	X	X	X	
WL-05	Measuring welding materials								X	X	X	X	
WL-06	Using clamps and jigs								X	X	X	X	
WL-07	Reading blueprints								X	X	X	X	
	Oxyacetylene Welding, Cutting, Brazing and Soldering												
WL-08	Following safety procedures and regulations for oxyacetylene welding								X		X	X	X
WL-09	Using oxyacetylene cylinder and gases								X		X	X	X
WL-10	Inspecting oxygen and acetylene regulators								X		X	X	X
WL-11	Selecting and maintaining oxyacetylene torches and tips								X		X	X	X
WL-12	Setting up and lighting the oxyacetylene torch								X		X	X	X
WL-13	Carrying a puddle without a filler rod								X		X		
WL-14	Welding an outside corner joint without a filler rod using oxyacetylene equipment								X		X		
WL-15	Making beads with filler rods using oxyacetylene equipment								X		X		
WL-16	Welding butt joints using oxyacetylene equipment								X		X		
WL-17	Welding lap joints using oxyacetylene equipment								X		X	X	
WL-18	Welding T-joints using oxyacetylene equipment								X		X	X	
WL-19	Setting up the oxyacetylene apparatus for flame cutting								X		X	X	
WL-20	Cutting with an oxyacetylene cutting torch										X		
WL-21	Piercing and cutting holes using the oxyacetylene cutting torch										X		
WL-22	Cutting with an automatic oxyacetylene cutting machine										X		
WL-23	Welding beads with brass rods using oxyacetylene welding equipment								X		X	X	
WL-24	Brazing a lap joint using oxyacetylene apparatus								X		X	X	
WL-25	Brazing with silver using oxyacetylene equipment								X		X	X	
WL-26	Soldering								X			X	
WL-27	Welding cast iron using oxyacetylene apparatus										X	X*	
WL-28	Cutting and welding pipe using oxyacetylene apparatus										X*		
	Shielded Arc Welding												
WL-29	Selecting and setting up shielded arc welding apparatus									X			X
WL-30	Welding string and weave beads using shielded arc welding apparatus									X			

COMPETENCY CHECKLIST

PROGRAM: METALS CLUSTER

STUDENT NAME: ____________________

EXIT POINTS

TASK NO.	UNIT COMPETENCIES	DATE	IN'T.	DOT NO. 604.685-026 JOB TITLE Lathe Operator	619.686-022 Sheet Metal Helper	605.685-030 Milling Machine Operator	606.682-014 Drill Press Operator	804.281-010 Sheet Metal Worker	810.384-014 Shielded-Metal Arc Welder	811.684-014 Oxyacetylene Welder	813.684-010 Brazer Assembler	819.687-014 Welder Helper
WL-31	Arc welding string beads and padding a plate								X			
WL-32	Arc welding lap joints								X			
WL-33	Arc welding butt joints								X			
WL-34	Shielded arc welding T-fillet joints								X			
WL-35	Testing arc welded joints								X			
	Inert Gas Welding											
WL-36	Identifying and describing tungsten inert gas welding processes								X			
WL-37	Following safety procedures and regulations for TIG welding								X			
WL-38	Identifying TIG welding equipment								X			
WL-39	Setting up TIG equipment to weld aluminum								X			
WL-40	Identifying and describing metal inert gas (MIG) welding process								X			
WL-41	MIG welding beads on mild steel plate								X			
WL-42	MIG welding butt joints using mild steel plate								X			
WL-43	MIG welding lap joints using mild steel plate								X			
WL-44	MIG welding fillet joints using mild steel plate								X			
WL-45	MIG welding with stainless steel								X			
WL-46	MIG welding with aluminum								X			
	Drilling Machine Work											
MS-01	Identifying parts and functions of the drilling machine						X	X				
MS-02	Identifying safety practices and precautions when using the drilling machine						X	X				
MS-03	Identifying work holding devices and set ups						X	X				
MS-04	Identifying and using drill bit holding devices						X	X				
MS-05	Identifying drill bits						X	X				
MS-06	Identifying cutting feeds and speeds						X	X				
MS-07	Identifying principles of straight drilling						X	X				
MS-08	Identifying and using coolants and cutting compounds						X	X				
MS-09	Grinding and care of drills						X	X				
MS-10	Identifying and using twist drill gages						X	X				
MS-11	Identifying and using drill grinding machines						X	X*				
MS-12	Identifying machine reamers						X					
MS-13	Machine reaming						X					
MS-14	Identifying principles of boring and counterboring						X					
MS-15	Spot facing						X					
MS-16	Countersinking, center drilling and tapping						X*					
	Power Saw Work											
MS-17	Identifying power cut-off saws			X		X			X			X
MS-18	Identifying power saw safety			X		X			X			X
MS-19	Identifying and using work holding devices on the power cut-off saw			X		X			X			X
MS-20	Identifying, selecting, mounting and maintaining saw blades			X		X			X			
MS-21	Identifying speeds, feeds and coolants for power cut off saws			X		X			X			

COMPETENCY CHECKLIST

EXIT POINTS

PROGRAM: METALS CLUSTER

STUDENT NAME:______________________________

DOT NO. JOB TITLE

TASK NO.	UNIT COMPETENCIES	DATE	N'T.	604.685-026 Lathe Operator	619.686-022 Sheet Metal Helper	605.685-030 Milling Machine Operator	606.682-014 Drill Press Operator	804.281-010 Sheet Metal Worker	810.384-014 Shielded-Metal Arc Welder	811.684-014 Oxyacetylene Welder	813.684-010 Brazer Assembler	819.687-014 Welder Helper
MS-22	Using the power cut-off saw for straight and angular sawing			X		X			X			X
MS-23	Identifying the metal band saw			X		X			X			X*
MS-24	Identifying coolants and lubricating agents for hand saws			X		X			X			
MS-25	Choosing saw blades for the metal band saw			X		X			X			
MS-26	Calculating feeds and speeds for the metal band saw			X		X			X*			
	Engine Lathe Work											
MS-27	Identifying lathe safety			X								
MS-28	Identifying lathes			X								
MS-29	Identifying work holding devices			X								
MS-30	Identifying cutting tools			X								
MS-31	Identifying measuring tools			X								
MS-32	Identifying lathe attachments			X								
MS-33	Calculating cutting feeds and speeds on the lathe			X								
MS-34	Determining RPM			X								
MS-35	Centering stock			X								
MS-36	Identifying principles of facing			X								
MS-37	Identifying principles of straight turning and turning to shoulders			X								
MS-38	Identifying checks			X								
MS-39	Form turning			X								
MS-40	Identifying faceplate work			X								
MS-41	Using draw-in collets			X								
MS-42	Identifying principles of drilling			X								
MS-43	Identifying machine reamers			X								
MS-44	Reaming on the engine lathe			X								
MS-45	Boring on the engine lathe			X								
MS-46	Identifying and using mandrels			X								
MS-47	Knurling on the engine lathe			X								
MS-48	Cutting off on the engine lathe			X								
MS-49	Identifying thread cutting devices			X								
MS-50	Identifying the parts of a thread			X								
MS-51	Identifying American National Thread Standards			X								
MS-52	Computing American National Thread form			X								
MS-53	Computing sharp V-thread formulas			X								
MS-54	Identifying Acme threads			X								
MS-55	Using the Acme tap			X								
MS-56	Identifying square threads			X								
MS-57	Identifying classes of fits of screw threads			X								
MS-58	Using thread gages			X								
MS-59	Using a thread micrometer			X								
MS-60	Measuring threads with the three-wire method			X								
MS-61	Cutting threads with an even geared lathe			X								
MS-62	Cutting threads on a lathe which is not even geared			X								
MS-63	Cutting threads on a quick-change gear lathe			X								
MS-64	Identifying multiple lead screw threads			X								

COMPETENCY CHECKLIST

PROGRAM: METALS CLUSTER

STUDENT NAME: ______________________________

EXIT POINTS

TASK NO.	UNIT COMPETENCIES	DATE	IN'T.	JOB TITLE: DOT NO.:	Lathe Operator 604.685-026	Sheet Metal Helper 619.686-022	Milling Machine Operator 605.685-030	Drill Press Operator 606.682-014	Sheet Metal Worker 804.281-010	Shielded-Metal Arc Welder 810.384-014	Oxyacetylene Welder 811.684-014	Brazer Assembler 813.684-010	Welder Helper 819.687-014
MS-65	Cutting left hand threads				X								
MS-66	Determining a tap drill size				X								
MS-67	Cutting interval threads and tapping				X								
MS-68	Identifying principles of taper turning				X								
MS-69	Computing tapers				X								
MS-70	Measuring short tapers				X								
MS-71	Gaging inside and outside tapers				X								
MS-72	Tapering by the offset tail stock methods				X								
MS-73	Cutting a taper with the compound rest				X								
MS-74	Cutting a taper with the taper attachment				X								
MS-75	Boring or turning interval tapers				X								
MS-76	Identifying coolants and cutting compounds				X								
MS-77	Identifying lubricants				X*								
	Milling Machine Work												
MS-78	Identifying types, sizes, construction, specifications, nomenclature and range of work for milling machines						X						
MS-79	Identifying milling machine work holding devices and their functions						X						
MS-80	Identifying, selecting and aligning milling machine attachments						X						
MS-81	Selecting and setting up milling machine cutters and holders						X						
MS-82	Calculating cutting speeds and feeds for milling machine work						X						
MS-83	Performing a plain milling operation						X						
MS-84	Performing a face milling operation						X						
MS-85	Performing a side milling operation						X						
MS-86	Performing a form milling operation						X						
MS-87	Performing an angular milling operation						X						
MS-88	Performing an end milling operation						X						
MS-89	Drilling, boring and reaming with the milling machine						X						
MS-90	Performing sawing, slitting and cutting off operations with the milling machine						X						
MS-91	Performing keyseating and T-slot milling operations						X						
MS-92	Performing indexing operations						X						
MS-93	Performing circular milling operations						X						
MS-94	Performing graduating and marking operations						X						

COMPETENCY CHECKLIST

PROGRAM: METALS CLUSTER

STUDENT NAME:______________________________

TASK NO.	UNIT COMPETENCIES	DATE	IN'T.	EXIT POINTS DOT NO. / JOB TITLE 604.685-026 Lathe Operator	619.686-022 Sheet Metal Helper	605.685-030 Milling Machine Operator	606.682-014 Drill Press Operator	804.281-010 Sheet Metal Worker	810.384-014 Shielded-Metal Arc Welder	811.684-014 Oxyacetylene Welder	813.684-010 Brazer Assembler	819.687-014 Welder Helper
MS-95	Performing profiling					X						
MS-96	Maintaining and caring for the milling machine					X*						

This is to certify that the above named student has demonstrated proficiency in the performance of the competencies and/or tasks indicated above. These competencies and/or tasks have been determined to be the skills and knowledge that are necessary for entry level employment into the job classifications indicated.

Date______________ Instructor________________________
School__________________________
Instructor________________________
Instructor________________________
Instructor________________________
Instructor________________________

*Certificate of Competency can be issued

CERTIFICATE OF COMPETENCY

This is to Certify that

David Mack Fitzpatrick

of

SAMPLE

Coffee County High School

has successfully mastered the competencies required to perform the job of

DRILL PRESS OPERATOR

Gerd Freudenhammer

December 20, 1981

The student named on this certificate has demonstrated mastery of the following unit level competencies required to perform the job of Drill Press Operator.

DRILL PRESS OPERATOR
(D.O.T. Code 606.682-014)

Metallurgy

Identifying metal manufacturing processes
Identifying the physical structure of metals
Identifying properties of metals
Identifying methods of heat treatment
Identifying iron manufacturing processes
Identifying processes used to produce steel
Identifying processes used to produce copper, brass and bronze alloys
Identifying processes used to produce aluminum
Identifying processes for the production of magnesium and titanium

Bench Work

Laying out metal surfaces
Identifying jig buttons
Using the sine bar
Using the bevel protractor
Using steel rules
Using the micrometer
Reading a vernier scale
Using dial indicators, center testers and speed indicators
Using precision gage blocks, tapered ring, plug and snap gages
Identifying and using hand hacksaws
Using abrasive and lapping compounds
Identifying and using files
Scraping flat and curved bearing surfaces
Using hammers and screwdrivers for hand bench use
Identifying and using wrenches
Using bench vices and clamps
Identifying and using chipping tools
Using hand taps, dies and hand reamers
Identifying power tool safety practices
Assembling and fitting
Identifying fasteners
Using thread, center, fillet and radius gages
Identifying lubricants and greases
Performing machine maintenance
Identifying bench work safety

Drilling Machine Work

Identifying parts and functions of the drilling machine
Identifying safety practices and precautions when using the drilling machine
Identifying work holding devices and set ups
Identifying and using drill bit holding devices
Identifying drill bits
Identifying cutting feeds and speeds
Identifying principles of straight drilling
Identifying and using coolants and cutting compounds
Grinding and care of drills
Identifying and using twist drill gages
Identifying and using drill grinding machines
Identifying machine reamers
Machine reaming
Identifying principles of boring and counterboring
Spot facing
Countersinking, center drilling and tapping

V-15

CERTIFICATE OF COMPETENCY

This is to Certify that

____

of

____

has successfully mastered the competencies required to perform the job of

Lathe Operator

____

____

The student named on this certificate has demonstrated mastery of the following unit level competencies required to perform the job of Lathe Operator.

LATHE OPERATOR
(D.O.T. Code 604.685-026)

Metallurgy

Identifying metal manufacturing processes
Identifying the physical structure of metals
Identifying properties of metals
Identifying methods of heat treatment
Identifying iron manufacturing processes
Identifying processes used to produce steel
Identifying processes used to produce copper, brass and bronze alloys
Identifying processes used to produce aluminum
Identifying processes for the production of magnesium and titanium

Bench Work

Laying out metal surfaces
Identifying jig buttons
Using the sine bar
Using the bevel protractor
Using steel rules
Using the micrometer
Reading a vernier scale
Using dial indicators, center testers and speed indicators
Using precision gage blocks, tapered ring, plug and snap gages
Identifying and using hand hacksaws
Using abrasives and lapping compounds
Identifying and using files
Scraping flat and curved bearing surfaces
Using hammers and screwdrivers for hand bench use
Identifying and using wrenches
Using bench vices and clamps
Identifying and using chipping tools
Using hand taps, dies and hand reamers
Identifying power tool safety practices
Assembling and fitting
Identifying fasteners
Using thread, center, fillet and radius gages
Identifying lubricants and greases
Performing machine maintenance
Identifying bench work safety

Power Saw Work

Identifying power cut-off saws
Identifying power saw safety
Identifying and using work holding devices on the power cut-off saw
Identifying, selecting, mounting and maintaining saw blades
Identifying speeds, feeds and coolants for power cut-off saws
Using the power cut-off saw for straight and angular sawing
Identifying the metal band saw
Identifying coolants and lubricating agents for band saws
Choosing saw blades for the metal band saw
Calculating feeds and speeds for the metal band saw

Engine Lathe Work

Identifying lathe safety
Identifying lathes
Identifying work holding devices
Identifying cutting tools
Identifying measuring tools
Identifying lathe attachments
Calculating cutting feeds and speeds on the lathe
Determining RPM
Centering stock
Identifying principles of facing
Identifying principles of straight turning and turning to shoulders
Identifying checks
Form turning
Identifying faceplate work
Using draw-in collets
Identifying principles of drilling
Identifying machine reamers
Reaming on the engine lathe
Boring on the engine lathe
Identifying and using mandrels
Knurling on the engine lathe
Cutting off on the engine lathe
Identifying thread cutting devices
Identifying the parts of a thread
Identifying American National Thread standards
Computing American National Thread form
Computing sharp V-thread formulas
Identifying Acme threads
Using the Acme tap
Identifying square threads
Identifying classes of fits of screw threads
Using thread gages
Using a thread micrometer
Measuring threads with the three-wire method
Cutting threads with an even geared lathe
Cutting threads on a lathe which is not even geared
Cutting threads on a quick-change gear lathe
Identifying multiple lead screw threads
Cutting left hand threads
Determining a tap drill size
Cutting interval threads and tapping
Identifying principles of taper turning
Computing tapers
Measuring short tapers
Gaging inside and outside tapers
Tapering by the offset tail stock methods
Cutting a taper with the compound rest
Cutting a taper with the taper attachment
Boring or turning interval tapers
Identifying coolants and cutting compounds
Identifying lubricants

CERTIFICATE OF COMPETENCY

This is to Certify that

____

of

____

has successfully mastered the competencies required to perform the job of

Sheet Metal Helper

____

____

The student named on this certificate has demonstrated mastery of the following unit level competencies required to perform the job of Sheet Metal Helper.

SHEET METAL HELPER
(D.O.T. CODE 619.686-022)

V-18

Metallurgy

Identifying metal manufacturing processes
Identifying the physical structure of metals
Identifying properties of metals
Identifying methods of heat treatment
Identifying iron manufacturing processes
Identifying processes used to produce steel
Identifying processes used to produce copper, brass and bronze alloys
Identifying processes used to produce aluminum
Identifying processes for the production of magnesium and titanium

Bench Work

Laying out metal surfaces
Identifying jig buttons
Using the sine bar
Using the bevel protractor
Using steel rules
Using the micrometer
Reading a vernier scale
Using dial indicators, center testers and speed indicators
Using precision gage blocks, tapered ring, plug and snap gages
Identifying and using hand hacksaws
Using abrasives and lapping compounds
Identifying and using files
Scraping flat and curved bearing surfaces
Using hammers and screwdrivers for hand bench use
Identifying and using wrenches
Using bench vices and clamps
Identifying and using chipping tools
Using hand taps, dies and hand reamers
Identifying power tool safety practices
Assembling and fitting
Identifying fasteners
Using thread, center, fillet and radius gages
Identifying lubricants and greases
Performing machine maintenance
Identifying bench work safety

Metal Fabrication

Identifying materials used in sheet metalwork
Cutting sheet metal

CERTIFICATE OF COMPETENCY

This is to Certify that

____

of

____

has successfully mastered the competencies required to perform the job of

Milling Machine Operator

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The student named on this certificate has demonstrated mastery of the following unit level competencies required to perform the job of Milling Machine Operator.

MILLING MACHINE OPERATOR
(D.O.T. Code 605.685-030)

Metallurgy

Identifying metal manufacturing processes
Identifying the physical structure of metals
Identifying properties of metals
Identifying methods of heat treatment
Identifying iron manufacturing processes
Identifying processes used to produce steel
Identifying processes used to produce copper, brass and bronze alloys
Identifying processes used to produce aluminum
Identifying processes for the production of magnesium and titanium

Bench Work

Laying out metal surfaces
Identifying jig buttons
Using the sine bar
Using the bevel protractor
Using steel rules
Using the micrometer
Reading a vernier scale
Using dial indicators, center testers and speed indicators
Using precision gage blocks, tapered ring, plug and snap gages
Identifying and using hand hacksaws
Using abrasives and lapping compounds
Identifying and using files
Scraping flat and curved bearing surfaces
Using hammers and screwdrivers for hand bench use
Identifying and using wrenches
Using bench vices and clamps
Identifying and using chipping tools
Using hand taps, dies and hand reamers
Identifying power tool safety practices
Assembling and fitting
Identifying fasteners
Using thread, center, fillet and radius gages
Identifying lubricants and greases
Performing machine maintenance
Identifying bench work safety

Power Saw Work

Identifying power cut-off saws
Identifying power saw safety
Identifying and using work holding devices on the power cut-off saw
Identifying, selecting, mounting and maintaining saw blades
Identifying speeds, feeds and coolants for power cut-off saws
Using the power cut-off saw for straight and angular sawing
Identifying the metal band saw
Identifying coolants and lubricating agents for band saws
Choosing saw blades for the metal band saw
Calculating feeds and speeds for the metal band saw

Milling Machine Work

Identifying types, sizes, construction, specifications, nomenclature and range of work for milling machines
Identifying milling machine work holding devices and their function
Identifying, selecting and aligning milling machine attachments
Selecting and setting up milling machine cutters and holders
Calculating cutting speeds and feeds for milling machine work
Performing a plain milling operation
Performing a face milling operation
Performing a side milling operation
Performing a form milling operation
Performing an angular milling operation
Performing an end milling operation
Drilling, boring and reaming with the milling machine
Performing sawing, slitting and cutting off operations with the milling machine
Performing keyseating and T-slot milling operations
Performing indexing operations
Performing circular milling operations
Performing graduating and marking operations
Performing profiling
Maintaining and caring for the milling machine

V-21

CERTIFICATE OF COMPETENCY

This is to Certify that

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of

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has successfully mastered the competencies required to perform the job of

Drill Press Operator

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The student named on this certificate has demonstrated mastery of the following unit level competencies required to perform the job of Drill Press Operator.

DRILL PRESS OPERATOR
(D.O.T. CODE 606.682-014)

Metallurgy

Identifying metal manufacturing processes
Identifying the physical structure of metals
Identifying properties of metals
Identifying methods of heat treatment
Identifying iron manufacturing processes
Identifying processes used to produce steel
Identifying processes used to produce copper, brass and bronze alloys
Identifying processes used to produce aluminum
Identifying processes for the production of magnesium and titanium

Bench Work

Laying out metal surfaces
Identifying jig buttons
Using the sine bar
Using the bevel protractor
Using steel rules
Using the micrometer
Reading a vernier scale
Using dial indicators, center testers and speed indicators
Using precision gage blocks, tapered ring, plug and snap gages
Identifying and using hand hacksaws
Using abrasives and lapping compounds
Identifying and using files
Scraping flat and curved bearing surfaces
Using hammers and screwdrivers for hand bench use
Identifying and using wrenches
Using bench vices and clamps
Identifying and using chipping tools
Using hand taps, dies and hand reamers
Identifying power tool safety practices
Assembling and fitting
Identifying fasteners
Using thread, center, fillet and radius gages
Identifying lubricants and greases
Performing machine maintenance
Identifying bench work safety

Drilling Machine Work

Identifying parts and functions of the drilling machine
Identifying safety practices and precautions when using the drilling machine
Identifying work-holding devices and set ups
Identifying and using drill bit holding devices
Identifying drill bits
Identifying cutting feeds and speeds
Identifying principles of straight drilling
Identifying and using coolants and cutting compounds
Grinding and care of drills
Identifying and using twist drill gages
Identifying and using drill grinding machines
Identifying machine reamers
Machine reaming
Identifying principles of boring and counterboring
Spot facing
Counter sinking, center drilling, and tapping

CERTIFICATE OF COMPETENCY

This is to Certify that

of

has successfully mastered the competencies required to perform the job of

Sheet Metal Worker

The student named on this certificate has demonstrated mastery of the following unit level competencies required to perform the job of Sheet Metal Worker.

SHEET METAL WORKER
(D.O.T. CODE 804.281-010)

Metallurgy

- Identifying metal manufacturing processes
- Identifying the physical structure of metals
- Identifying properties of metals
- Identifying methods of heat treatment
- Identifying iron manufacturing processes
- Identifying processes used to produce steel
- Identifying processes used to produce copper, brass and bronze alloys
- Identifying processes used to produce aluminum
- Identifying processes for the production of magnesium and titanium

Bench Work

- Laying out metal surfaces
- Identifying jig buttons
- Using the sine bar
- Using the bevel protractor
- Using steel rules
- Using the micrometer
- Reading a vernier scale
- Using dial indicators, center testers and speed indicators
- Using precision gage blocks, tapered ring, plug and snap gages
- Identifying and using hand hacksaws
- Using abrasives and lapping compounds
- Identifying and using files
- Scraping flat and curved bearing surfaces
- Using hammers and screwdrivers for hand bench use
- Identifying and using wrenches
- Using bench vices and clamps
- Identifying and using chipping tools
- Using hand taps, dies and hand reamers
- Identifying power tool safety practices
- Assembling and fitting
- Identifying fasteners
- Using thread, center, fillet and radius gages
- Identifying lubricants and greases
- Performing machine maintenance
- Identifying bench work safety

Metal Fabrication

- Identifying materials used in sheet metal work
- Developing sheet metal patterns (stretch-outs)
- Cutting sheet metal
- Bending sheet metal by hand
- Bending metal on a bar folder or brake
- Roll-forming sheet metal
- Making seams
- Using the rotary machine
- Fastening sheet metal
- Soft soldering sheet metal

Foundations

- Practicing safety
- Identifying and using welding symbols
- Using welding related shop tools and equipment
- Identifying and preparing metals for welding
- Measuring welding materials
- Using clamps and jigs
- Reading blueprints

Oxyacetylene Welding, Cutting, Brazing and Soldering

- Following safety procedures and regulations for oxyacetylene welding
- Using oxyacetylene cylinders and gases
- Inspecting oxygen and acetylene regulators
- Selecting and maintaining oxyacetylene torches and tips
- Setting up and lighting the oxyacetylene torch
- Carrying a puddle without a fillet rod
- Welding an outside corner joint without a filler rod using oxyacetylene equipment
- Making beads with filler rods using oxyacetylene equipment
- Welding butt joints using oxyacetylene equipment
- Welding lap joints using oxyacetylene equipment
- Welding T-joints using oxyacetylene equipment
- Setting up the oxyacetylene apparatus for flame cutting
- Welding beads with brass rods using oxyacetylene welding equipment
- Brazing a lap joint using oxyacetylene apparatus
- Brazing with silver using oxyacetylene equipment
- Soldering

Drilling Machine Work

- Identifying parts and functions of the drilling machine
- Identifying safety practices and precautions when using the drilling machine
- Identifying work holding devices and set ups
- Identifying and using drill bit holding devices
- Identifying drill bits
- Identifying cutting feeds and speeds
- Identifying principles of straight drilling
- Identifying and using coolants and cutting compounds
- Grinding and care of drills
- Identifying and using twist drill gages
- Identifying and using drill grinding machines

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CERTIFICATE OF COMPETENCY

This is to Certify that

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of

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has successfully mastered the competencies required to perform the job of

Shielded - Metal Arc Welder

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The student named on this certificate has demonstrated mastery of the following unit level competencies required to perform the job of Shielded-Metal Arc Welder.

SHIELDED-METAL ARC WELDER
(D.O.T. CODE 810.384-014)

Metallurgy

Identifying metal manufacturing processes
Identifying the physical structure of metals
Identifying properties of metals
Identifying methods of heat treatment
Identifying iron manufacturing processes
Identifying processes used to produce steel
Identifying processes used to produce copper, brass and bronze alloys
Identifying processes used to produce aluminum
Identifying processes for the production of magnesium and titanium

Bench Work

Laying out metal surfaces
Identifying jig buttons
Using the sine bar
Using the bevel protractor
Using steel rules
Using the micrometer
Reading a vernier scale
Using dial indicators, center testers and speed indicators
Using precision gage blocks, tapered ring, plug and snap gages
Identifying and using hand hacksaws
Using abrasives and lapping compounds
Identifying and using files
Scraping flat and curved bearing surfaces
Using hammers and screwdrivers for hand bench use
Identifying and using wrenches
Using bench vices and clamps
Identifying and using chipping tools
Using hand taps, dies and hand reamers
Identifying power tool safety practices
Assembling and fitting
Identifying fasteners
Using thread, center, fillet and radius gages
Identifying lubricants and greases
Performing machine maintenance
Identifying bench work safety

Foundations

Practicing safety
Identifying and using welding symbols
Using welding related shop tools and equipment
Identifying and preparing metals for welding
Measuring welding materials
Using clamps and jigs
Reading blueprints

Shielded Arc Welding

Selecting and setting up shielded arc welding apparatus
Welding string and weave beads using shielded arc welding apparatus
Arc welding string beads and padding a plate
Arc welding lap joints
Arc welding butt joints
Shielded arc welding T-fillet joints
Testing arc welded joints

Inert Gas Welding

Identifying and describing tungsten inert gas welding processes
Following safety procedures and regulations for TIG welding
Identifying TIG welding equipment
Setting up TIG equipment to weld aluminum
Identifying and describing metal inert gas (MIG) welding processes
MIG welding beads on mild steel plate
MIG welding butt joints using mild steel plate
MIG welding lap joints using mild steel plate
MIG welding fillet joints using mild steel plate
MIG welding with stainless steel
MIG welding with aluminum

Power Saw Work

Identifying power cut-off saws
Identifying power saw safety
Identifying and using work holding devices on the power cut-off saw
Identifying, selecting, mounting and maintaining saw blades
Identifying speeds, feeds and coolants for power cut-off saws
Using the power cut-off saw for straight and angular sawing
Identifying the metal band saw
Identifying coolants and lubricating agents for band saws
Choosing saw blades for the metal band saw
Calculating feeds and speeds for the metal band saw

CERTIFICATE OF COMPETENCY

This is to Certify that

of

has successfully mastered the competencies required to perform the job of

Oxyacetylene Welder

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The student named on this certificate has demonstrated mastery of the following unit level competencies required to perform the job of Oxyacetylene Welder.

OXYACETYLENE WELDER
(D.O.T. Code 811.684-014)

Metallurgy

- Identifying metal manufacturing processes
- Identifying the physical structure of metals
- Identifying properties of metals
- Identifying methods of heat treatment
- Identifying iron manufacturing processes
- Identifying processes used to produce steel
- Identifying processes used to produce copper, brass and bronze alloys
- Identifying processes used to produce aluminum
- Identifying processes for the production of magnesium, and titanium

Bench Work

- Laying out metal surfaces
- Identifying jig buttons
- Using the sine bar
- Using the bevel protractor
- Using steel rules
- Using the micrometer
- Reading a vernier scale
- Using dial indicators, center testers and speed indicators
- Using precision gage blocks, tapered ring, plug and snap gages
- Identifying and using hand hacksaws
- Using abrasives and lapping compounds
- Identifying and using files
- Scraping flat and curved bearing surfaces
- Using hammers and screwdrivers for hand bench use
- Identifying and using wrenches
- Using bench vices and clamps
- Identifying and using chipping tools
- Using hand taps, dies and hand reamers
- Identifying power tool safety practices
- Assembling and fitting
- Identifying fasteners
- Using thread, center, fillet and radius gages
- Identifying lubricants and greases
- Performing machine maintenance
- Identifying bench work safety

Foundations

- Practicing safety
- Identifying and using welding symbols
- Using welding related shop tools and equipment
- Identifying and preparing metals for welding
- Measuring welding materials
- Using clamps and jigs
- Reading blueprints

Oxyacetylene Welding, Cutting, Bracing and Soldering

- Following safety procedures and regulations for oxyacetylene welding
- Using oxyacetylene cylinders and gases
- Inspecting oxygen and acetylene regulators
- Selecting and maintaining oxyacetylene torches and tips
- Setting up and lighting the oxyacetylene torch
- Carrying a puddle without a filler rod
- Welding an outside corner joint without a filler rod using oxyacetylene equipment
- Making beads with filler rods using oxyacetylene equipment
- Welding lap joints using oxyacetylene equipment
- Welding T-joints using oxyacetylene equipment
- Setting up the oxyacetylene apparatus for flame cutting
- Cutting with an oxyacetylene cutting torch
- Piercing and cutting holes using the oxyacetylene cutting torch
- Cutting with an automatic oxyacetylene cutting machine
- Welding beads with brass rods using oxyacetylene welding equipment
- Brazing a lap joint using oxyacetylene apparatus
- Brazing with silver using oxyacetylene equipment
- Welding cast iron using oxyacetylene apparatus
- Cutting and welding pipe using oxyacetylene apparatus

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CERTIFICATE OF COMPETENCY

This is to Certify that

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of

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has successfully mastered the competencies required to perform the job of

Brazer Assembler
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The student named on this certificate has demonstrated mastery of the following unit level competencies required to perform the job of Brazer Assembler.

BRAZER ASSEMBLER
(D.O.T. Dode 813.684-010)

Metallurgy

Identifying metal manufacturing processes
Identifying the physical structure of metals
Identifying properties of metals
Identifying methods of heat treatment
Identifying iron manufacturing processes
Identifying processes used to produce steel
Identifying processes used to produce copper, brass and bronze alloys
Identifying processes used to produce aluminum
Identifying processes for the production of magnesium and titanium

Bench Work

Laying out metal surfaces
Identifying jig buttons
Using the sine bar
Using the bevel protractor
Using steel rules
Using the micrometer
Reading a vernier scale
Using dial indicators, center testers and speed indicators
Using precision gage blocks, tapered ring, plug and snap gages
Identifying and using hand hacksaws
Using abrasives and lapping compounds
Identifying and using files
Scraping flat and curbed bearing surfaces
Using hammers and screwdrivers for hand bench use
Identifying and using wrenches
Using bench vices and clamps
Identifying and using chipping tools
Using hand taps, dies and hand reamers
Identifying power tool safety practices
Assembling and fitting
Identifying fasteners
Using thread, center, fillet and radius gages
Identifying lubricants and greases
Performing machine maintenance
Identifying bench work safety

Oxyacetylene Welding, Cutting, Brazing and Soldering

Welding butt joints using oxyacetylene equipment
Welding lap joints using oxyacetylene equipment
Welding T-joints using oxyacetylene equipment
Welding beads with brass rods using oxyacetylene welding equipment
Brazing a lap joint using oxyacetylene apparatus
Brazing with silver using oxyacetylene equipment
Soldering
Welding cast iron using oxyacetylene apparatus

CERTIFICATE OF COMPETENCY

This is to Certify that

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of

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has successfully mastered the competencies required to perform the job of

Welder Helper

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The student named on this certificate has demonstrated mastery of the following unit level competencies required to perform the job of Welder Helper.

WELDER HELPER
(D.O.T. Code 819.687-014)

Metallurgy

Identifying metal manufacturing processes
Identifying the physical structure of metals
Identifying properties of metals
Identifying methods of heat treatment
Identifying iron manufacturing processes
Identifying processes used to produce steel
Identifying processes used to produce copper, brass and bronze alloys
Identifying processes used to produce aluminum
Identifying processes for the production of magnesium and titanium

Bench Work

Laying out metal surfaces
Identifying jig buttons
Using the sine bar
Using the bevel protractor
Using steel rules
Using the micrometer
Reading a vernier scale
Using dial indicators, center testers and speed indicators
Using precision gage blocks, tapered ring, plug and snap gages
Identifying and using hand hacksaws
Using abrasives and lapping compounds
Identifying and using files
Scraping flat and curved bearing surfaces
Using hammers and screwdrivers for hand bench use
Identifying and using wrenches
Using bench vices and clamps
Identifying and using chipping tools
Using hand taps, dies and hand reamers
Identifying power tool safety practices
Assembling and fitting
Identifying fasteners
Using thread, center, fillet and radius gages
Identifying lubricants and greases
Performing machine maintenance
Identifying bench work safety

Oxyacetylene Welding, Cutting, Brazing and Soldering

Following safety procedures and regulations for oxyacetylene welding
Using oxyacetylene cylinders and gases
Inspecting oxygen and acetylene regulators
Selecting and maintaining oxyacetylene torches and tips
Setting up and lighting the oxyacetylene torch
Setting up the oxyacetylene apparatus for flame cutting

Shielded Arc Welding

Selecting and setting up shielded arc welding apparatus

Power Saw Work

Identifying power cut-off saws
Identifying power saw safety
Identifying and using work holding devices on the power cut-off saw
Using the power cut-off saw for straight and angular sawing
Identifying the metal band saw

GROUP PROGRESS CHART

NAME	UNITS/TASKS																				

SECTION VI

FACILITIES

SECTION VI

Section VI Content List

Group Instruction Facilities
Individualized Instruction Facilities

The facility layouts on the following pages are presented to aid in arranging the classroom and laboratory for efficient instruction. The school administration and program instructor must determine an arrangement that best fits the needs of the students by determining the most efficient use of resources available to them not only in the laboratory, but also in the Learning Resource Center settings.

FACILITY LAYOUTS

The layouts on the following pages illustrate how facilities for group and individualized instructional programs may be planned and set up.

Each instructional approach has two important physical areas. These are (1) the laboratory (work) area and classroom for group instruction and (2) the laboratory (work) area and learning resource center (LRC) for individualized instruction.

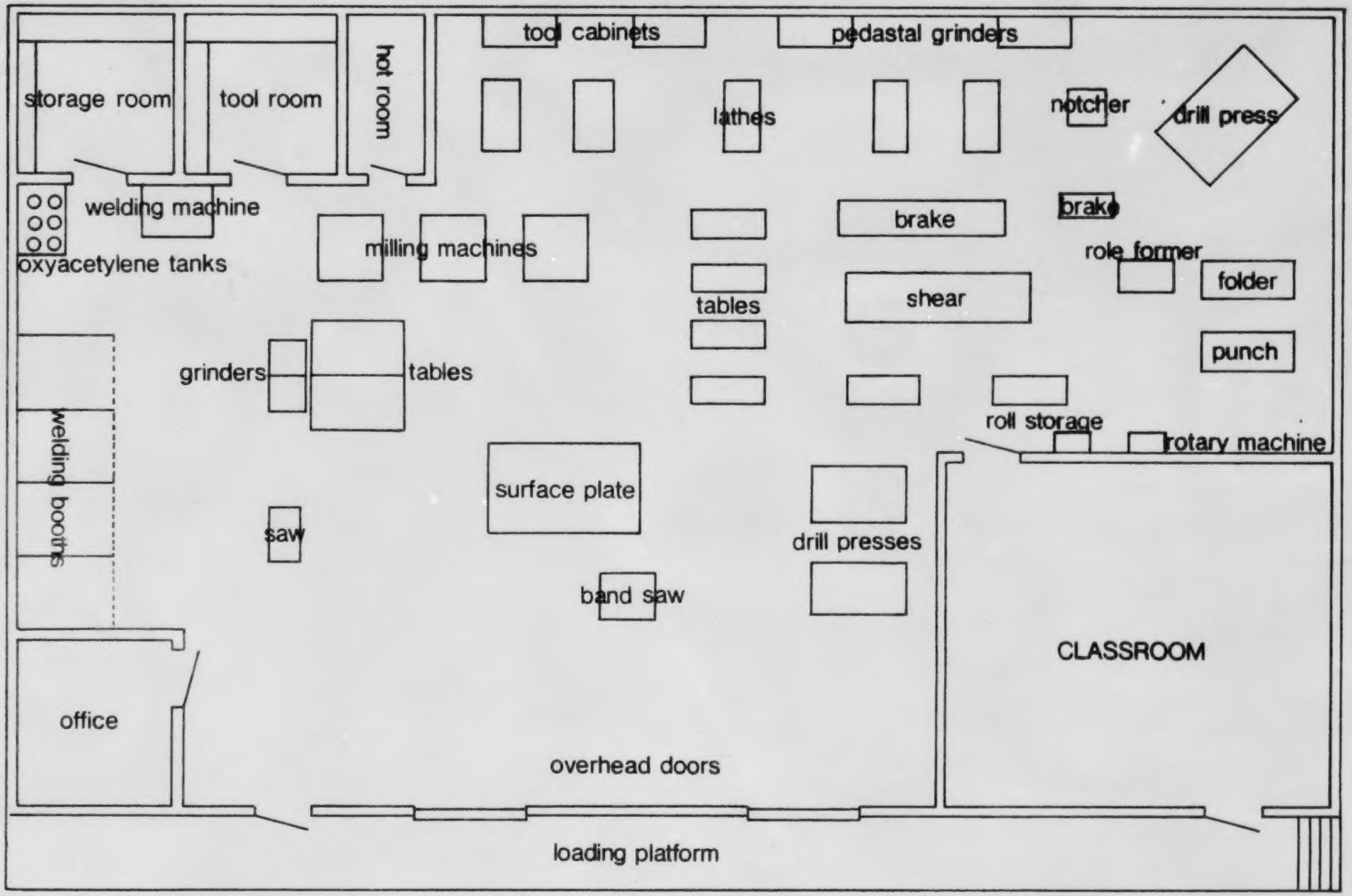
The instructional setting for group instruction is based on that of a traditional classroom. This approach is easily set up and includes little or no modifications. The primary modes of learning are instructor lectures, occasional use of audiovisual aids and student participation. Ideally, all students progress at the same pace.

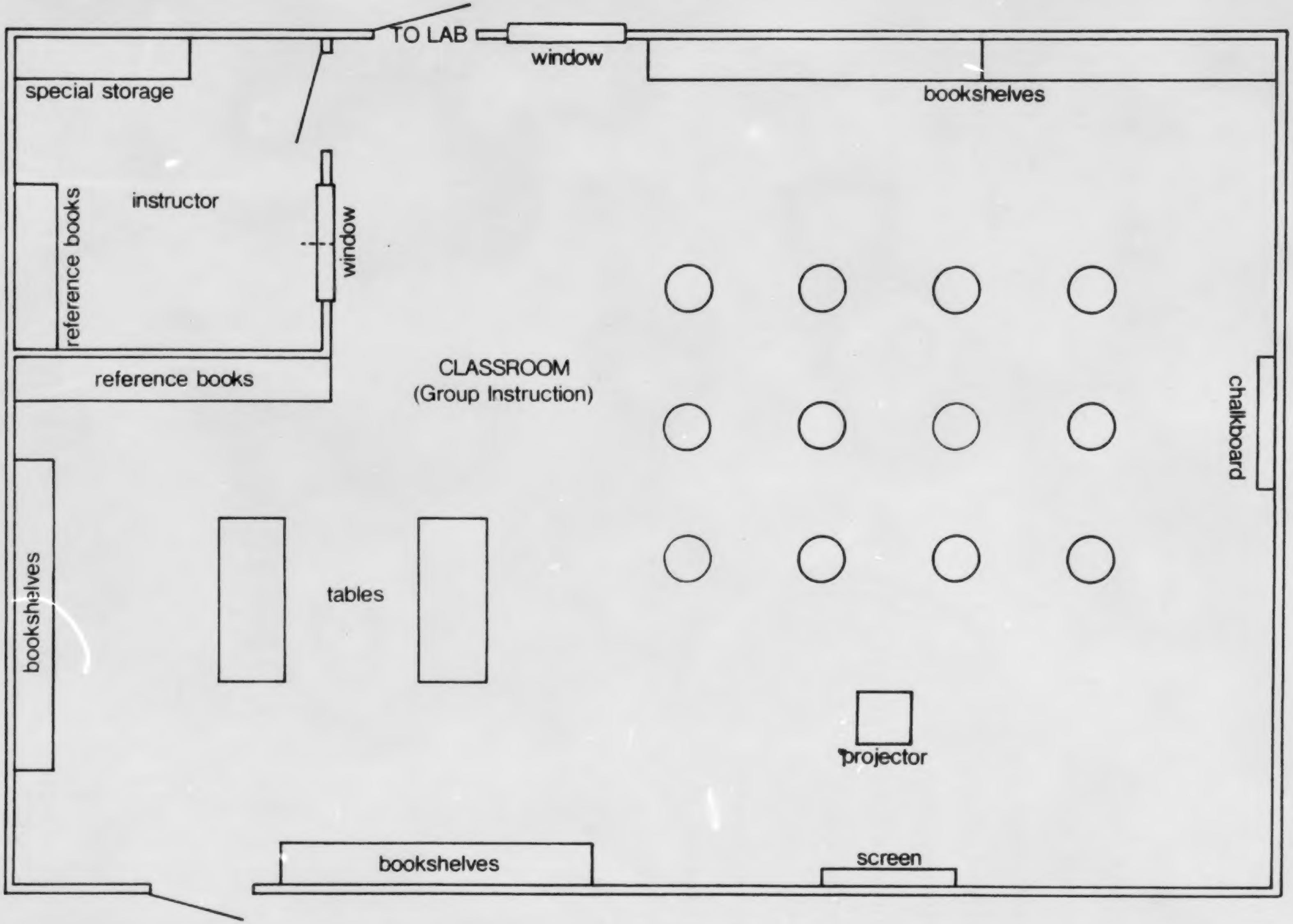
The instructional setting for individual instruction is designed to facilitate a student self-paced progression of learning. The LRC requires careful planning in utilizing available space. When planning to install an individual instruction program in an area not originally designed for this approach, the instructional setting may need modifications. Desks may be replaced with study carrels to allow students to simultaneously participate in a variety of learning activities. A group session area for small group gatherings should also be included. Because the instructor and students rarely meet together as a group, a bulletin board becomes a vital communication device in an LRC. It can be used to post announcements and such instructional information as group progress charts, assignments, positions available in the industry and safety rules.

A variety of references, resources and media equipment should be made available to the student. Therefore, an adequate amount of storage area should be included in planning the LRC. Every specific school and department has unique physical layout characteristics and problems. Through innovation, these features may be transformed into LRC advantages rather than disadvantages.

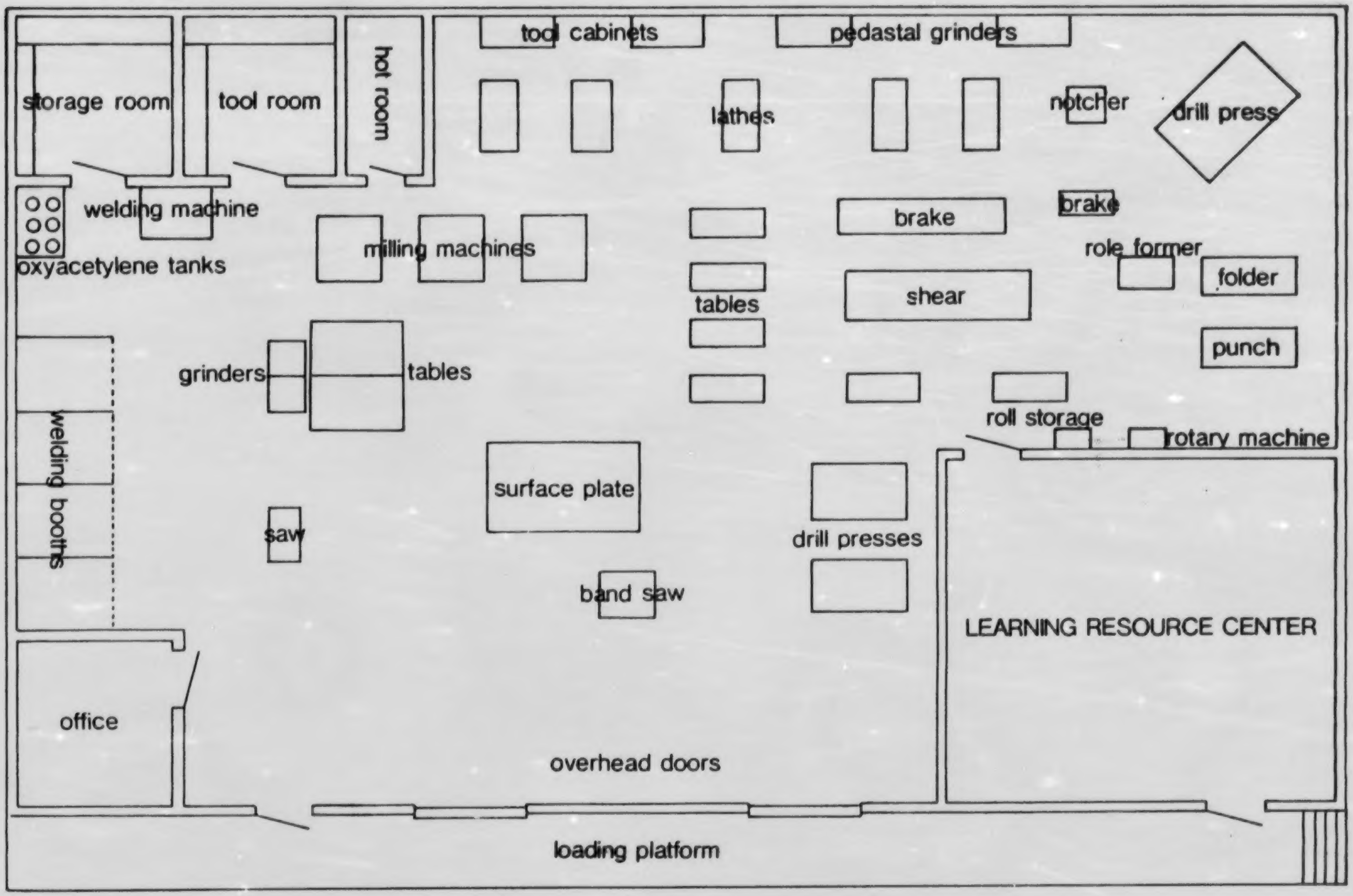
The manner in which the laboratory (work) area is planned and set up need not be affected by the type of instructional approach used by an instructor; it could/will be the same. Some major concerns in the laboratory are: 1) the instructor must always have a clear line of sight to each and every workstation, 2) tools must be accessible to students, but under the control of the instructor and 3) all supplies and materials required for the day's activities must be on hand and ready to use.

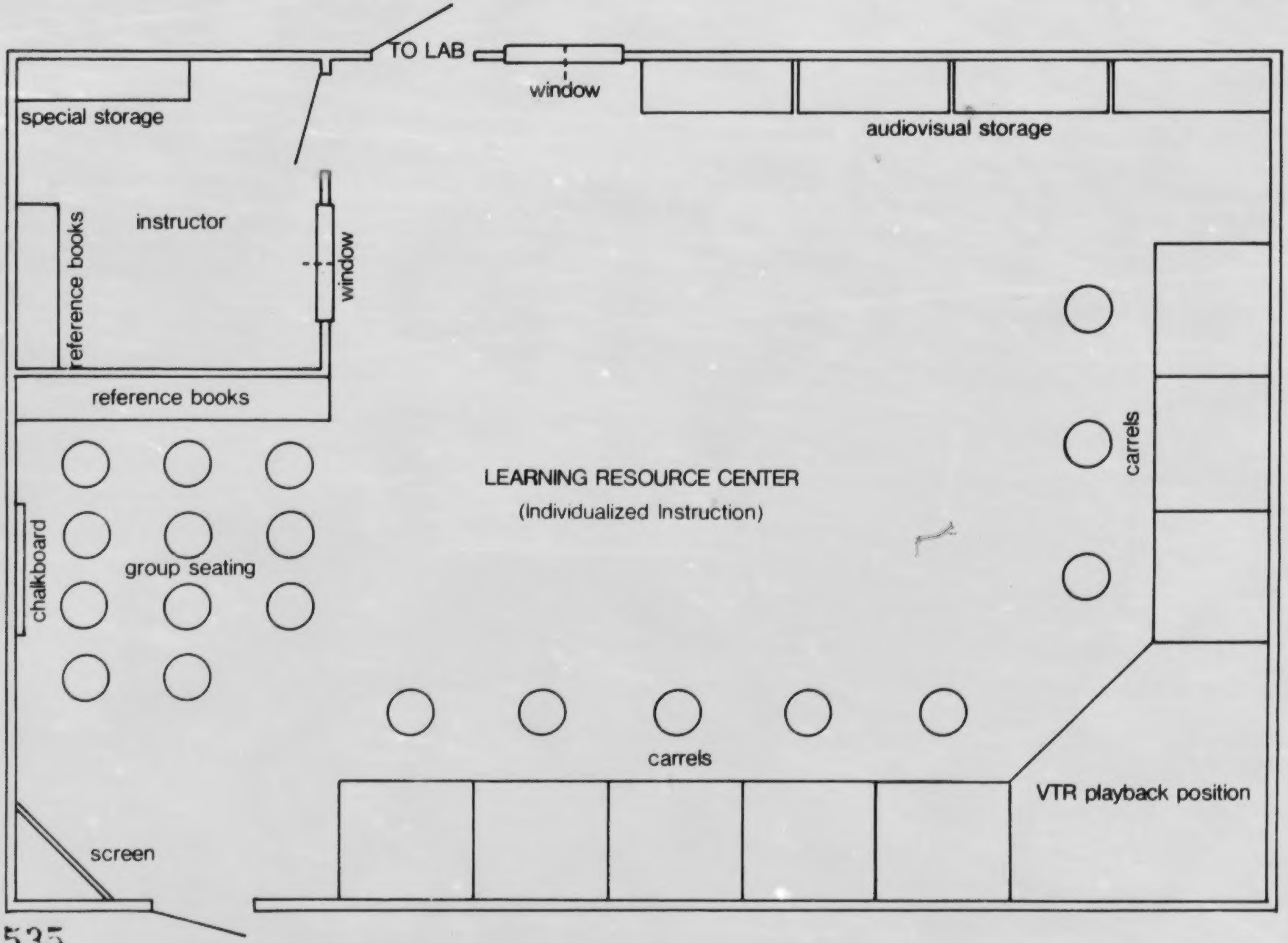
METALS CLUSTER LABORATORY LAYOUT


tool cabinets
pedastal grinders
storage room
tool room
hot room
lathes
notcher
drill press
welding machine
oxyacetylene tanks
milling machines
brake
brake
role former
folder
tables
shear
punch
grinders
tables
welding booths
roll storage
rotary machine
surface plate
saw
drill presses
band saw
CLASSROOM
office
overhead doors
loading platform


TO LAB
window
special storage
bookshelves
instructor
reference books
window
reference books
CLASSROOM
(Group Instruction)
chalkboard
bookshelves
tables
projector
bookshelves
screen

METALS CLUSTER LABORATORY LAYOUT


tool cabinets
pedastal grinders
storage room
tool room
hot room
lathes
notcher
drill press
welding machine
brake
brake
oxyacetylene tanks
milling machines
role former
folder
tables
shear
punch
grinders
tables
welding booths
roll storage
rotary machine
surface plate
saw
drill presses
band saw
LEARNING RESOURCE CENTER
office
overhead doors
loading platform


TO LAB
window
special storage
audiovisual storage
instructor
reference books
window
reference books
LEARNING RESOURCE CENTER
(Individualized Instruction)
carrels
chalkboard
group seating
carrels
VTR playback position
screen

APPENDIX A

Resources

RESOURCES

This appendix contains the instructional resource matrix, unit guide references, additional instructional materials and resource addresses.

The instructional resource matrix lists the audiovisuals, textbooks and student manuals for each task referenced on unit guide sheets. The audiovisual format is identified by symbols such as: filmstrip (FS), slide/script (SS), slide/tape (ST), 16mm movie film (MF), transparency (TR), video tape (VT) and filmloop (FL). The producer and title of the A/V is also given.

The unit guide bibliography lists textbooks, audiovisuals and student manuals and evaluation materials cited in the unit guides section.

The additional instructional materials is a compilation of textbooks not included in the unit guides but beneficial to educators.

Resource addresses for all references conclude this appendix.

CURRICULUM AREA: Metals Cluster (General Metals)

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audiovisuals	Textbooks	Student Materials
GM-01 Identifying metal manufacturing processes	Bergwall: #506, "Foundry Work" (FS)	Kibbe: Machine Tool Practices	
GM-02 Identifying the physical structure of metals		Burghardt: Machine Tool Operation (Part II); Kibbe: Machine Tool Practices	Ohio: Machine Trades II, Metallurgy Assignment Sheet #1
GM-03 Identifying properties of metals		Burghardt: Machine Tool Operation (Part II)	Ohio: Machine Trades II, Metallurgy Assignment Sheet #2
GM-04 Identifying methods of heat treatment		Burghardt: Machine Tool Operation (Part II)	Ohio: Machine Trades II, Heat Treating Assignment Sheets #1-11
GM-05 Identifying iron manufacturing processes		Burghardt: Machine Tool Operation (Part II)	Ohio: Machine Trades II, Metallurgy Assignment Sheets #3, 4
GM-06 Identifying processes used to produce steel		Burghardt: Machine Tool Operation (Part II)	Ohio: Machine Trades II, Metallurgy Assignment Sheets #6-13
GM-07 Identifying processes used to produce copper, brass and bronze alloys		Burghardt: Machine Tool Operation (Part II)	Ohio: Machine Trades II, Metallurgy Assignment Sheet #14
GM-08 Identifying processes used to produce aluminum		Burghardt: Machine Tool Operation (Part II)	Ohio: Machine Trades II, Metallurgy Assignment Sheet #15

CURRICULUM AREA: Metals Cluster (General Metals)

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audiovisuals	Textbooks	Student Materials
GM-09 Identifying processes for the production of magnesium and titanium		Kibbe: Machine Tool Practices	Ohio: Machine Trades II, Metallurgy Assignment Sheet #16
GM-10 Laying out metal surfaces	Bergwall: #505, "Bench Metal Work" (FS); Prentice-Hall: #VD930-1, "Machine Shop: Bench Operations" (FS)	Burghardt: Machine Tool Operation (Part I); Porter: Machine Shop Operations and Setups	Ohio: Machine Trades I, Bench Work Assignment Sheet #1; Georgia: Metal Fabrication Cluster, BSMO-1
GM-11 Identifying jig buttons		Burghardt: Machine Tool Operation (Part I); Kibbe: Machine Tool Practices	Ohio: Machine Tools I, Bench Work Assignment Sheet #1
GM-12 Using the sine bar	Bergwall: #503-5, "Measuring Tools Explained" (FS)	Burghardt: Machine Tool Operation (Part I); Porter: Machine Shop Operations and Setups	Ohio: Machine Trades I, Bench Work Assignment Sheet #3; Machine Shop Training Course, Vol. 1
GM-13 Using the bevel protractor	Bergwall: #503, "Measuring Tools Explained" (FS)	Burghardt: Machine Tool Operation (Part I); Kibbe: Machine Tool Practices	Ohio: Machine Trades I, Bench Work Assignment Sheet #4
GM-14 Using steel rules	Bergwall: #505-1, "Bench Metal Work" (FS); Prentice-Hall: #VD930-1, "Machine Shop: Bench Operations" (FS)	Burghardt: Machine Tool Operation (Part I); Kibbe: Machine Tool Practices; Porter: Machine Shop Operations and Setups	Ohio: Machine Trades I, Bench Work Assignment Sheet #5

CURRICULUM AREA: Metals Cluster (General Metals)

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audiovisuals	Textbooks	Student Materials
GM-15 Using the micrometer	Bergwall: #503-2, 3, 4, "Measuring Tools Explained" (FS)	Burghardt: Machine Tool Operation (Part I); Kibbe: Machine Tool Practices; Porter: Machine Shop Operations and Setups	Ohio: Machine Trades I, Bench Work Assignment Sheet #6; Georgia: Metal Fabrication Cluster, M-1 thru M-7
GM-16 Reading a vernier scale	Bergwall: #503-1, "Measuring Tools Explained" (FS)	Burghardt: Machine Tool Operation (Part I); Kibbe: Machine Tool Practices; Porter: Machine Shop Operations and Setups	Ohio: Machine Trades I, Bench Work Assignment Sheet #7; Georgia: Metal Fabrication Cluster, MV-1 thru MV-5
GM-17 Using dial indicators, center testers and speed indicators	Bergwall: #503-5, "Measuring Tools Explained" (FS)	Burghardt: Machine Tool Operation (Part I); Kibbe: Machine Tool Practices; Porter: Machine Shop Operations and Setups	Ohio: Machine Trades I, Bench Work Assignment Sheet #8; Machine Shop Training Course, Vol, I
GM-18 Using precision gage blocks, tapered ring, plug and snap gages	Bergwall: #503-4, "Measuring Tools Explained" (FS)	Burghardt: Machine Tool Operation (Part I); Kibbe: Machine Tool Practices; Porter: Machine Shop Operations and Setups	Ohio: Machine Trades I, Bench Work Assignment Sheet #9; Machine Shop Training Course, Vol. I
GM-19 Identifying and using hand hacksaws	Bergwall: #505-2, "Bench Metal Work" (FS); Prentice-Hall: #VD930-2, "Machine Shop: Bench Operations" (FS)	Burghardt: Machine Tool Operation (Part I); Kibbe: Machine Tool Practices; Porter: Machine Shop Operations and Setups	Ohio: Machine Trades I, Bench Work Assignment Sheet #10
GM-20 Using abrasives and lapping compounds	Bergwall: #501, "The Lathe Explained" (FS)	Burghardt: Machine Tool Operation (Part I); Kibbe: Machine Tool Practices; Porter: Machine Shop Operations and Setups	Ohio: Machine Trades I, Bench Work Assignment Sheet #11

CURRICULUM AREA: Metals Cluster (General Metals)

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audiovisuals	Textbooks	Student Materials
GM-21 Identifying and using files	Bergwall: #503-3, "Bench Metal Work" (FS); Prentice-Hall: #VD930-2, "Machine Shop: Bench Operation" (FS)	Burghardt: Machine Tool Operation (Part I); Kibbe: Machine Tool Practices; Porter: Machine Shop Operations and Setups	Ohio: Machine Trades I, Bench Work Assignment Sheet #12
GM-22 Scraping flat and curved bearing surfaces	Bergwall: #505-1, "Bench Metal Work" (FS)	Burghardt: Machine Tool Operation (Part I); Kibbe: Machine Tool Practices; Porter: Machine Shop Operations and Setups	Ohio: Machine Trades I, Bench Work Assignment Sheet #13
GM-23 Using hammers and screwdrivers for hand bench use	Bergwall: #505-6, "Bench Metal Work" (FS)	Burghardt: Machine Tool Operation (Part I); Kibbe: Machine Shop Operations and Setups	Ohio: Machine Trades I, Bench Work Assignment Sheet #14
GM-24 Identifying and using wrenches	Bergwall: #505-6, "Bench Metal Work" (FS)	Burghardt: Machine Tool Operation (Part I); Kibbe: Machine Tool Practices; Porter: Machine Shop Operations and Setups	Ohio: Machine Trades I, Bench Work Assignment Sheet #15
GM-25 Using bench vises and clamps		Burghardt: Machine Tool Operation (Part I); Kibbe: Machine Tool Practices; Porter: Machine Shop Operations and Setups	Ohio: Machine Trades I, Bench Work Assignment Sheet #16
GM-26 Identifying and using chipping tools		Burghardt: Machine Tool Operation (Part I); Kibbe: Machine Tool Practices; Porter: Machine Shop Operations and Setups	Ohio: Machine Trades I, Bench Work Assignment Sheet #17; Machine Shop Training Course, Vol. 2

CURRICULUM AREA: Metals Cluster (General Metals)

TASK LISTING		INSTRUCTIONAL MATERIAL REFERENCES		
		Audiovisuals	Textbooks	Student Materials
GM-27	Using hand taps, dies and hand reamers	Bergwall: #505-5, "Bench Metal Work" (FS); Prentice-Hall: #VD930-4 "Machine Shop: Bench Operations" (FS)	Burghardt: Machine Tool Operation (Part I); Kibbe: Machine Tool Practices; Porter: Machine Shop Operations and Setups	Ohio: Machine Trades I, Bench Work Assignment Sheet #18
GM-28	Identifying power tool safety practices	Bergwall: #514, "Working With Power Tools and Machines" (FS)		Ohio: Machine Trades I, Bench Work Assignment Sheet #19
GM-29	Assembling and fitting	Bergwall: #505-6, "Bench Metal Work" (FS)	Burghardt: Machine Tool Operation (Part I); Kibbe: Machine Tool Practices; Porter: Machine Shop Operations and Setups	Ohio: Machine Trades I, Bench Work Assignment Sheet #20; Machine Shop Training Course, Vol. I
GM-30	Identifying fasteners	Prentice-Hall: #XF1128-3, "Working with Nuts and Bolts" (FS)	Burghardt: Machine Tool Operation (Part I); Kibbe: Machine Tool Practices	Ohio: Machine Trades I, Bench Work Assignment Sheet #21; Machine Shop Training Course, Vol. I
GM-31	Using thread, center, fillet and radius gages	Bergwall: #503, "Measuring Tools Explained" (FS)	Burghardt: Machine Tool Operation (Part I); Kibbe: Machine Tool Practices; Porter: Machine Shop Operations and Setups	Ohio: Machine Trades I, Bench Work Assignment Sheet #22; Machine Shop Training Course, Vol. I
GM-32	Identifying lubricants and greases	Bergwall: #501, "The Lathe Explained" (FS)		Ohio: Machine Trades I, Bench Work Assignment Sheet #23
GM-33	Performing machine maintenance	Prentice-Hall: #XF928, "Machine Shop: Engine Lathe" (FS)	Specific manufacturer's service manuals	Ohio: Machine Trades I, Bench Work Assignment Sheet #24

CURRICULUM AREA: Metals Cluster (General Metals)

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audiovisuals	Textbooks	Student Materials
GM-34 Identifying bench work safety	Bergwall: #514, "Metal Shop Safety" (FS)	Burghardt: Machine Tool Operation (Part I); Kibbe: Machine Tool Practices; Porter: Machine Shop Operations and Setups	Ohio: Machine Trades I, Bench Work Assignment Sheet #25

CURRICULUM AREA: Metals (Sheet Metal)

TASK LISTING		INSTRUCTIONAL MATERIAL REFERENCES		
		Audiovisuals	Textbooks	Student Materials
SM-01	Identifying materials used in sheet metalwork	Bergwall Productions, Inc.: #507-1, "Sheet Metalwork" (FS)	Johnson: *Technical Metals*; Feirer: *Basic Metalwork*	
SM-02	Developing sheet metal patterns (stretchouts)	Bergwall: #507-2, 507-3, "Sheet Metalwork" (FS)	Johnson: *Technical Metals*; Feirer: *Basic Metalwork*	Georgia: *Metal Fabrication Cluster*, BSMO-1, BSMO-2, BSMO-8, MSB-1, MSB-2
SM-03	Cutting sheet metal	Bergwall: #507-4, "Sweet Metalwork" (FS); Prentice-Hall: #XF934-1, "Sheet Metalwork" (FS)	Johnson: *Technical Metals*; Feirer: *Basic Metalwork*	Georgia: *Metal Fabrication Cluster*, BSMO-3, BSMO-4, BSMO-5, BSMO-7, BSMO-9
SM-04	Bending sheet metal by hand	Bergwall: #507-6, "Sheet Metalwork" (FS)	Johnson: *Technical Metals*; Feirer: *Basic Metalwork*	Georgia: *Metal Fabrication Cluster*, BSMO-10, BSMO-11, MSB-4
SM-05	Bending metal on a bar folder or brake	Bergwall: #507-7, "Sheet Metalwork" (FS)	Johnson: *Technical Metals*; Feirer: *Basic Metalwork*	Georgia: *Metal Fabrication Cluster*, BSMO-13, BSMO-14, BSMO-15
SM-06	Roll-forming sheet metal	Bergwall: #507-6, "Sheet Metalwork" (FS)	Johnson: *Technical Metals*; Feirer: *Basic Metalwork*	Georgia: *Metal Fabrication Cluster*, SMP-1
SM-07	Making seams	Prentice-Hall: #XF934-4, "Sheet Metalwork" (FS); Bergwall Productions, Inc.: #507-7, "Sheet Metalwork" (FS)	Johnson: *Technical Metals*; Feirer: *Basic Metalwork*	Georgia: *Metal Fabrication Cluster*, BSMO-6, BSMO-12, SMP-2 thru SMP-9
SM-08	Using the rotary machine		Johnson: *Technical Metals*; Feirer: *Basic Metalwork*	

CURRICULUM AREA: Metals (Sheet Metals)

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audiovisuals	Textbooks	Student Materials
SM-09 Fastening sheet metal	Bergwall: #507-7, "Sheet Metalwork" (FS); Prentice-Hall: #XF934-2, "Sheet Metalwork" (FS)	Johnson: Technical Metals; Feirer: Basic Metalwork	
SM-10 Soft soldering sheet metal	Prentice-Hall: #XF934-3, "Sheet Metalwork" (FS); Bergwall: #507-7, "Sheet Metalwork" (FS)	Johnson: Technical Metals; Feirer: Basic Metalwork	Georgia: Welding, Phase A, Unit A-20; Georgia: Metal Fabrication Cluster, BSMO-16, MSB-5

CURRICULUM AREA: Metals Cluster (Welding)

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audiovisuals	Textbooks	Student Materials
WL-01 Orienting students to to the welding program	Georgia: A-04, "General Shop Safety" (ST)	Georgia: Welding, Instructor Guide; Giachino: Welding Skills and Practices; Griffin: Welding Processes; Oregon: Welding	Georgia: Welding, Phase A, Unit 1
WL-02 Identifying and using welding symbols		Griffin: Welding Processes; Schell: Industrial Welding Procedures	
WL-03 Using welding related shop tools		Griffin: Welding Processes; Schell: Industrial Welding Procedures	
WL-04 Identifying and preparing metals for welding	Georgia: A-7, "Metallurgy" (ST)	Georgia: Welding, Instructor Guide; Giachino: Welding Skills and Practices; Griffin: Welding Processes; Oregon: Welding	Georgia: Welding, Phase A, Unit 7
WL-05 Measuring welding materials		Georgia: Welding, Instructor Guide; Oregon: Welding	Georgia: Welding, Phase A, Unit A-7A; Georgia: Metal Fabrication Cluster, AW-3
WL-06 Using clamps and jigs		Griffin: Basic TIG and MIG Welding	
WL-07 Reading blueprints		Bennett: Blueprint Reading for Welders	

CURRICULUM AREA: Metals Cluster (Welding)

TASK LISTING		INSTRUCTIONAL MATERIAL REFERENCES		
		Audiovisuals	Textbooks	Student Materials
WL-08	Following safety procedures and regulations for oxyacetylene welding	Georgia: A-5A, "Safety" (ST); Georgia: A-5B, "Safety" (ST)	Georgia: Welding, Instructor Guide; Giachino: Welding Skills and Practices; Griffin: Basic Oxyacetylene Welding; Althouse: Modern Welding	Georgia: Welding, Phase A, Unit 5
WL-09	Using oxyacetylene cylinders and gases	Georgia: A-2, "Cylinders and Gases" (ST); Bergwall: #902-1, "Welding Explained: Oxyacetylene Fusion" (FS); Prentice-Hall: #XF964-1, "Oxyacetylene Welding" (FS) or #XF72003-100 (FL)	Georgia: Welding, Instructor Guide; Giachino: Welding Skills and Practices; Griffin: Basic Oxyacetylene Welding; Althouse: Modern Welding; Oregon: Welding	Georgia: Welding, Phase A Unit 2
WL-10	Inspecting oxygen and acetylene regulators	Georgia: A-3, "Regulators" (ST)	Georgia: Welding, Instructor Guide; Giachino: Welding Skills and Practices; Griffin: Basic Oxyacetylene Welding; Althouse: Modern Welding; Oregon: Welding	Georgia: Welding, Phase A, Unit 3
WL-11	Selecting and maintaining oxyacetylene torches and tips	Georgia: A-4, "Torches and Tips" (ST); Bergwall: #902-2, "Welding Explained: Oxyacetylene Fusion" (ST)	Georgia: Welding, Instructor Guide; Giachino: Welding Skills and Practices; Griffin: Basic Oxyacetylene Welding; Althouse: Modern Welding; Oregon: Welding	Georgia: Welding, Phase A, Unit 4

CURRICULUM AREA: Metals Cluster (Welding)

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audiovisuals	Textbooks	Student Materials
WL-12 Setting up and lighting the oxyacetylene torch	Georgia: A-6, "Setting Up and Lighting the Torch" (ST); Bergwall: #902-3, "Welding Explained: Oxyacetylene Fusion" (FS); Prentice-Hall: #XF964-2, XF-964-3, "Oxyacetylene Welding" (FS) or #XF72003-100 (FL)	Georgia: Welding, Instructor Guide; Giachino: Welding Skills and Practices; Griffin: Basic Oxyacetylene Welding; Althouse: Modern Welding; Oregon: Welding	Georgia: Welding, Phase A, Unit 6; Georgia: Metal Fabrication Cluster, GW-1
WL-13 Carrying a puddle without a filler rod	Georgia: A-8, "Carrying a Puddle Without a Rod" (ST); Bergwall: #902-4, "Welding Explained: Oxyacetylene Fusion" (FS); Prentice-Hall: #XF964-4 (FS) or #XF72003-100 (FL)	Georgia: Welding, Instructor Guide; Giachino: Welding Skills and Practices; Griffin: Basic Oxyacetylene Welding; Althouse: Modern Welding; Oregon: Welding	Georgia: Metal Fabrication Cluster, GW-2; Georgia: Welding, Phase A, Unit 8
WL-14 Welding an outside corner joint without a filler rod, using oxyacetylene equipment	Georgia: A-9, "Welding an Outside Corner Joint" (ST); Bergwall: #902-5, "Welding Explained: Oxyacetylene Fusion" (FS)	Georgia: Welding, Instructor Guide; Giachino: Welding Skills and Practices; Griffin: Basic Oxyacetylene Welding; Althouse: Modern Welding; Oregon: Welding	Georgia: Metal Fabrication Cluster, GW-4; Georgia: Welding, Phase A, Unit 9
WL-15 Making beads with filler rods, using oxyacetylene equipment		Georgia: Welding, Instructor Guide; Giachino: Welding Skills and Practices; Griffin: Basic Oxyacetylene Welding; Oregon: Welding	Georgia: Metal Fabrication Cluster, GW-5; Georgia: Welding, Phase A, Unit 10

CURRICULUM AREA: Metals Cluster (Welding)

TASK LISTING		INSTRUCTIONAL MATERIAL REFERENCES		
		Audiovisuals	Textbooks	Student Materials
WL-16	Welding butt joints using oxyacetylene equipment	Georgia: A-11, "Welding in a Flat Position" (ST); Georgia: A-12, "Vertical and Overhead Welding" (ST); Bergwall: #902-5, "Welding Explained: Oxyacetylene Fusion" (FS); Prentice-Hall: #XF964-5, "Oxyacetylene Welding" (FS) or #XF-72003-100 (FL)	Georgia: *Welding*, Instructor Guide; Giachino: *Welding Skills and Practices*; Griffin: *Basic Oxyacetylene Welding*; Althouse: *Modern Welding*; Oregon: *Welding*	Georgia: *Metal Fabrication Cluster*, GW-6; Georgia: *Welding, Phase A*, Units A-11 and A-12
WL-17	Welding lap joints using oxyacetylene equipment	Bergwall: #902-5, "Welding Explained: Oxyacetylene Fusion" (FS)	Georgia: *Welding*, Instructor Guide; Giachino: *Welding Skills and Practices*; Griffin: *Basic Oxyacetylene Welding*; Althouse: *Modern Welding*; Oregon: *Welding*	Georgia: *Metal Fabrication Cluster*, GW-7; Georgia: *Welding, Phase A*, Unit 12
WL-18	Welding T-joints using oxyacetylene equipment	Georgia: A-13, "Welding T-Joints" (ST)	Georgia: *Welding*, Instructor Guide; Giachino: *Welding Skills and Practices*; Griffin: *Basic Oxyacetylene Welding*; Althouse: *Modern Welding*; Oregon: *Welding*	Georgia: *Metal Fabrication Cluster*, GW-8; Georgia: *Welding, Phase A*, Unit A-13
WL-19	Setting up the oxyacetylene apparatus for flame cutting	Georgia: A-14, "The Flame Cutting Process" (ST); Bergwall: #903-1, "Oxyacetylene Cutting Explained" (FS); Prentice-Hall: #XF-964, "Oxyacetylene Welding" (FS)	Georgia: *Welding*, Instructor Guide; Giachino: *Welding Skills and Practices*; Griffin: *Basic Oxyacetylene Welding*; Althouse: *Modern Welding*; Oregon: *Welding*	Georgia: *Metal Fabrication Cluster*, GC-1; Georgia: *Welding, Phase A*, Unit A-14

CURRICULUM AREA: Metals Cluster (Welding)

TASK LISTING		INSTRUCTIONAL MATERIAL REFERENCES		
		Audiovisuals	Textbooks	Student Materials
WL-20	Cutting with an oxyacetylene cutting torch	Georgia: A-15, "Cutting a Straight Line" (ST); Bergwall: #903-2, "Oxyacetylene Welding" (FS); Prentice-Hall: #XF964-7, "Oxyacetylene Welding" (FS)	Georgia: Welding, Instructor Guide; Giachino: Welding Skills and Practices; Griffin: Basic Oxyacetylene Welding; Althouse: Modern Welding; Oregon: Welding	Georgia: Metal Fabrication Cluster, GC-2, GC-3, GC-5; Georgia: Welding, Phase A, Unit A-15
WL-21	Piercing and cutting holes using the oxyacetylene cutting torch	Georgia: A-16, "Cutting and Piercing Holes" (ST); Bergwall: #903-2, "Oxyacetylene Cutting Explained" (FS); Prentice-Hall: #XF964, "Oxyacetylene Welding" (FS)	Georgia: Welding, Instructor Guide; Giachino: Welding Skills and Practices; Griffin: Basic Oxyacetylene Welding; Althouse: Modern Welding; Oregon: Welding	Georgia: Metal Fabrication Cluster, GC-4; Georgia: Welding, Phase A, Unit A-16
WL-22	Cutting with an automatic oxyacetylene cutting machine	Georgia: A-17, "Setting Up the Automatic Cutting Machine" (ST)	Georgia: Welding, Instructor Guide; Althouse: Modern Welding; Cutting Machine Manual; Oregon: Welding	Georgia: Welding, Phase A, Unit A-17
WL-23	Welding beads with brass rods using oxyacetylene welding equipment	Georgia: A-18, "Running Beads With a Brass Rod" (ST); Prentice-Hall: #XF964-6, "Oxyacetylene Welding" (FS) or #XF72003-(FL)	Georgia: Welding, Instructor Guide; Giachino: Welding Skills and Practices; Griffin: Basic Oxyacetylene Welding; Althouse: Modern Welding; Oregon: Welding	Georgia: Metal Fabrication Cluster, BW-1; Georgia: Welding, Phase A, Unit A-18

CURRICULUM AREA: Metals Cluster (Welding)

TASK LISTING		INSTRUCTIONAL MATERIAL REFERENCES		
		Audiovisuals	Textbooks	Student Materials
WL-24	Brazing a lap joint using oxyacetylene apparatus	Prentice-Hall: #XF964-6, "Oxyacetylene Welding" (FS) or #XF72003-100 (FL)	Georgia: Welding, Instructor Guide; Giachino: Welding Skills and Practices; Griffin: Basic Oxyacetylene Welding; Althouse: Modern Welding; Oregon: Welding	Georgia: Metal Fabrication Cluster, BW-5; Georgia: Welding, Phase A, Unit A-19
WL-25	Brazing with silver using oxyacetylene equipment		Oregon: Welding	
WL-26	Soldering	Georgia: A-20, "Silver Soldering Process" (ST)	Georgia: Welding, Instructor Guide; Althouse: Modern Welding; Oregon: Welding	Georgia: Welding, Phase A, Unit A-20
WL-27	Welding cast iron using oxyacetylene apparatus	Georgia: A-21, "Welding in Cast Iron" (ST)	Georgia: Welding, Instructor Guide; Giachnio: Welding Skills and Practices; Althouse: Modern Welding	Georgia: Welding, Phase A, Unit A-21
WL-28	Cutting and welding pipe using oxyacetylene apparatus	Georgia: A-22, "Pipe Welding" (ST)	Georgia: Welding, Instructor Guide; Giachino: Welding Skills and Practices; Althouse: Modern Welding; Oregon: Welding	Georgia: Welding, Phase A, Unit A-22

CURRICULUM AREA: Metals Cluster (Welding)

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audiovisuals	Textbooks	Student Materials
WL-29 Selecting and setting up shielded arc welding apparatus	Georgia: B-1, "Introduction to Shielded Arc Welding" (ST); Georgia: B-2, "Shielded Arc Welding Safety" (ST); Georgia: B-3, "Identification of Arc Welding Machines" (ST); Georgia: B-4, "Electrical Circuits" (ST); Georgia: B-6, "Setting Up Welding Machine and Striking an Arc" (ST); Georgia: B-9, "Identifying and Selecting Electrodes" (ST); Bergwall: #904, "Electric Arc Welding Explained" (FS); Prentice-Hall: #XF963-1, #XF963-2, "Arc Welding" (FS)	Georgia: Welding, Instructor Guide; Giachino: Welding Skills and Practices; Althouse: Modern Welding; Oregon: Welding; Griffin: Basic Arc Welding	Georgia: Welding, Phase B, Units B-2, B-2, B-3, B-4A, B-5, B-6 and B-9; Georgia: Metal Fabrication Cluster, AW-1
WL-30 Welding string and weave beads using shielded arc welding apparatus	Georgia: B-23, "Weld String and Weave Beads in the Overhead Position" (ST); Bergwall: #904-5, "Electric Arc Welding Explained" (FS); Prentice-Hall: #XF963-4, #XF963-5, "Arc Welding" (FS) or #XFJH2091, "Basic Electric Arc Welding" (FL)	Georgia: Welding, Instructor Guide; Giachino: Welding Skills and Practices; Oregon: Welding; Griffin: Basic Arc Welding	Georgia: Welding, Phase B, Units B-23, B-24, B-34, B-37
WL-31 Arc welding string beads and padding a plate	Georgia: B-7, "Welding a Pad of Beads in the Flat Position" (ST); Prentice-Hall: #XF963-3, "Arc Welding" (FS) or #XFJH2902, "Basic Electric Arc Welding" (FL)	Georgia: Welding, Instructor Guide; Giachino: Welding Skills and Practices; Althouse: Modern Welding; Oregon: Welding; Griffin: Basic Arc Welding	Georgia: Metal Fabrication Cluster, AW-2; Georgia: Welding, Phase B, Units B-7, B-12, B-16, B-18

CURRICULUM AREA. Metal Cluster (Welding)

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audiovisuals	Textbooks	Student Materials
WL-32 Arc welding lap joints	Georgia: B-10, "Welding a Lap Joint in the Horizontal Position" (ST); Bergwall: #904 B-6, "Positional Welding" (FS); Prentice-Hall: #XF963-3, "Arc Welding" (FS)	Georgia: Welding, Instructor Guide; Althouse: Modern Welding; Oregon: Welding; Schell: Industrial Welding Procedures; Griffin: Basic Arc Welding	Georgia: Metal Fabrication Cluster, AW-7; Georgia: Welding, Phase B, Units B-10, B-14, B-20, B-25, B-36, B-39
WL-33 Arc welding butt joints	Georgia: B-8, "Welding Butt Joints in the Flat Position" (ST); Bergwall: #904B, "Positional Welding" (FS); Prentice-Hall: #XF-963-5, "Arc Welding" (FS) or #XFJH2908; 2911; 2912; 2913, "Basic Electric Arc Welding" (FL)	Giachino: Welding Skills and Practices; Althouse: Modern Welding; Oregon: Welding; Schell: Industrial Welding Procedures; Georgia: Welding, Instructor Guide; Griffin: Basic Arc Welding	Georgia: Metal Fabrication Cluster, AW-5, AW-9; Georgia: Welding, Phase B, Units B-8, B-13, B-17, B-19, B-24, B-27, B-30, B-32, B-35, and B-38
WL-34 Shield arc welding T-fillet joints	Bergwall: #904B, "Positional Welding" (FS); Prentice-Hall: #XF963-5, "Arc Welding" (FS) or #XFJH2904; 2909; 2914, "Basic Electric Arc Welding" 100 (FL)	Giachino: Welding Skills and Practices; Althouse: Modern Welding; Oregon: Welding; Schell: Industrial Welding Procedures; Georgia: Welding, Instructor Guide; Griffin: Basic Arc Welding	Georgia: Metal Fabrication Cluster, AW-6, AW-10, AW-11; Georgia: Welding, Phase B, Units B-11, B-15, B-21, B-22, B-26, B-31 and B-33
WL-35 Testing arc welded joints		Giachino: Welding Skills and Practices; Griffin: Basic Arc Welding; Althouse: Modern Welding; Oregon: Welding; Georgia: Welding, Instructor Guide	Georgia: Welding, Phase B, Unit B-40

CURRICULUM AREA Metals Cluster (Welding)

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audiovisuals	Textbooks	Student Materials
WL-36 Orientation to tungsten inert gas arc welding	Georgia: C-1, "Introduction to Tungsten Inert Gas Welding" (ST); Prentice-Hall: #XF1169-1, "Gas Shielded Arc Welding (TIG/MIG)" (FS)	Giachino: Welding Skills and Practices; Althouse: Modern Welding; Schell: Industrial Welding Procedures; Oregon: Welding; Georgia: Welding, Instructor Guide: Griffin: Basic TIG and MIG Welding	Georgia: Metal Fabrication Cluster, TW-1; Georgia: Welding, Phase C, Unit C-1
WL-37 Following safety procedures and regulations for TIG welding	Georgia: C-2, "Safety Hazards in Welding" (ST); Prentice-Hall: #XF1169-1, "Gas Shielded Arc Welding (TIG/MIG)" (FS)	Althouse: Modern Welding; Giachino: Welding Skills and Practices; Schell: Industrial Welding Procedures; Georgia: Welding, Instructor Guide; Griffin: Basic TIG and MIG Welding	Georgia: Welding, Phase C, C-2
WL-38 Identifying TIG welding equipment	Georgia: C-3, "TIG Welding Equipment" (ST); Prentice-Hall: #XF1169-1, #XF1169-2, "Gas Shielded Arc Welding (TIG/MIG)" (FS)	Althouse: Modern Welding; Giachino: Welding Skills and Practices; Schell: Industrial Welding Procedures; Georgia: Welding, Instructor Guide; Griffin: Basic TIG and MIG Welding	Georgia: Welding, Phase C, Unit C-3
WL-39 Setting up TIG equipment to weld aluminum	Georgia: C-4, "Setting Up TIG Equipment to Weld Aluminum" (ST); Prentice-Hall: #XF1169-3, "Gas Shielded Arc Welding (TIG/MIG)" (FS)	Althouse: Modern Welding; Giachino: Welding Skills and Practices; Schell: Industrial Welding Procedures; Georgia: Welding, Instructor Guide; Griffin: Basic TIG and MIG Welding	Georgia: Metal Fabrication Cluster, TW-2; Georgia: Welding, Phase C, Unit C-4

CURRICULUM AREA: Metals Cluster (Welding)

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audiovisuals	Textbooks	Student Materials
WL-40 MIG orientation and safety	Georgia: D-1, "Introduction to Inert Gas Welding" (ST); Georgia: D-2, "Gas Metal Arc Welding Safety" (ST); Georgia: D-3, "Identification of Gas Metal Arc Welding Machines" (ST); Prentice Hall: #XF1169-4, "Gas Shielded Arc Welding" (FS)	Giachino: Welding Skills and Practices; Sacks: Welding: Principles and Practices; Schell: Industrial Welding Procedures; Georgia: Welding, Instructor Guide; Griffin: Basic TIG and MIG Welding	Georgia: Welding, Phase D, Units D-1, D-2, and D-3
WL-41 MIG welding beads on mild steel plate	Georgia: D-4, "Setting Up Machine and Running Beads" (ST); Prentice-Hall: #XF1169-2, "Gas Shielded Arc Welding (TIG/MIG)" (FS)	Giachino: Welding Skills and Practices; Schell: Industrial Welding Procedures; Georgia: Welding, Instructor Guide; Griffin: Basic TIG and MIG Welding	Georgia: Welding, Phase D, Unit D-4
WL-42 MIG welding butt joints using mild steel	Georgia: D-5, "Weld a Butt Joint in the Flat Position" (ST); Georgia: D-9, "Weld a Butt Joint in the Vertical Position" (ST); Prentice-Hall: #XF1169-2, "Gas Shielded Arc Welding (TIG/MIG)" (FS)	Giachino: Welding Skills and Practices; Schell: Industrial Welding Procedures; Georgia: Welding, Instructor Guide; Griffin: Basic TIG and MIG Welding	Georgia: Welding, Phase D, Units D-5, D-8, D-9, D-12, D-15, D-16
WL-43 MIG welding lap joints using mild steel plate	Georgia: D-6, "Weld a Lap Joint in the Horizontal Position" (ST)	Giachino: Welding Skills and Practices; Schell: Industrial Welding Procedures; Georgia: Welding, Instructor Guide; Griffin: Basic TIG and MIG Welding	Georgia: Welding, Phase D, Unit D-6

CURRICULUM AREA: Metal Cluster (Welding)

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audiovisuals	Textbooks	Student Materials
WL-44 MIG welding fillet joints using mild steel plate		Giachino: Welding Skills and Practices; Schell: Industrial Welding Procedures; Georgia: Welding, Instructor Guide; Griffin: Basic TIG and MIG Welding	Georgia: Welding, Phase D, Units D-7, D-10, D-11, D-13, and D-14
WL-45 MIG welding with stainless steel		Giachino: Welding Skills and Practices; Sacks: Welding Principles and Practices; Schell: Industrial Welding Procedures; Georgia: Welding, Instructor Guide; Griffin: Basic TIG and MIG Welding	Georgia: Welding, Phase D, Units D-17 and D-18
WL-46 MIG welding with aluminum		Giachino: Welding Skills and Practices; Sacks: Welding Principles and Practices; Schell: Industrial Welding Procedures; Georgia: Welding, Instructor Guide; Griffin: Basic TIG and MIG Welding	Georgia: Welding, Phase D, Units D-19 and D-20

CURRICULUM AREA: Metals Cluster (Machine Shop)

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audiovisuals	Textbooks	Student Materials
MS-01 Identifying parts and functions of the drilling machine	Prentice-Hall: #XF929-1, "Machine Shop: Drill Press" (FS)	Burghardt: Machine Tool Operation (Part I); Kibbe: Machine Tool Practices; Porter: Machine Shop Operations and Setups	Georgia: Metal Fabrication Cluster, DP-1; Ohio: Machine Trades I, Drilling Machine Work Assignment Sheet #1
MS-02 Identifying safety practices and precautions when using the drilling machine	Prentice-Hall: #XF929-1, "Machine Shop: Drill Press" (FS)	Burghardt: Machine Tool Operation (Part I); Kibbe: Machine Tool Practices; Porter: Machine Shop Operations and Setups	Ohio: Machine Trades I, Drilling Machine Work Assignment Sheet #2
MS-03 Identifying work holding devices and set ups	Prentice-Hall: #XF929-1, "Machine Shop: Drill Press" (FS)	Burghardt: Machine Tool Operation (Part I); Kibbe: Machine Tool Practices; Porter: Machine Shop Operations and Setups	Georgia: Metal Fabrication Cluster, DP-4; Ohio: Machine Trades I, Drilling Machine Work Assignment Sheet #3
MS-04 Identifying and using drill bit holding devices	Prentice-Hall: #XF929-2, "Machine Shop: Drill Press" (FS)	Burghardt: Machine Tool Operation (Part I); Kibbe: Machine Tool Practices; Porter: Machine Shop Operations and Setups	Ohio: Machine Trades I, Drilling Machine Work Assignment Sheet #4
MS-05 Identifying drill bits		Burghardt: Machine Tool Operation (Part I); Kibbe: Machine Tool Practices; Porter: Machine Shop Operations and Setups	Ohio: Machine Trades I, Drilling Machine Work Assignment Sheet #5
MS-06 Identifying cutting feeds and speeds		Burghardt: Machine Tool Operation (Part I); Kibbe: Machine Tool Practices; Porter: Machine Shop Operations and Setups	Ohio: Machine Trades I, Drilling Machine Work Assignment Sheet #6; Georgia: Metal Fabrication Cluster, DP-2

CURRICULUM AREA: Metals Cluster (Machine Shop)

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audiovisuals	Textbooks	Student Materials
MS-07 Identifying principles of straight drilling	Bergwall: #505-5, "Bench Metalwork" (FS); Prentice-Hall: #XF929, "Machine Shop: Drill Press" (FS)	Burghardt: Machine Tool Operation (Part I); Kibbe: Machine Tool Practices; Porter: Machine Shop Operations and Setups	Georgia: Metal Fabrication Cluster, DP-3; Ohio: Machine Trades I, Drilling Machine Work Assignment Sheet #7
MS-08 Identifying and using coolants and cutting compounds	Bergwall: #505-5, "Bench Metalwork" (FS); Prentice-Hall: #XF929, "Machine Shop: Drill Press" (FS)	Burghardt: Machine Tool Operation (Part I); Kibbe: Machine Tool Practices; Porter: Machine Shop Operations and Setups	Ohio: Machine Trades I, Drilling Machine Work Assignment Sheet #8
MS-09 Grinding and care of drills	Bergwall: #505-5, "Bench Metalwork" (FS); Prentice-Hall: #XF929, "Machine Shop: Drill Press" (FS)	Burghardt: Machine Tool Operation (Part I); Kibbe: Machine Tool Practices; Porter: Machine Shop Operations and Setups	Ohio: Machine Trades I, Drilling Machine Work Assignment Sheet #9
MS-10 Identifying and using twist drill gages	Bergwall: #505-5, "Bench Metalwork" (FS); Prentice-Hall: #XF919, "Machine Shop: Drill Press" (FS)	Burghardt: Machine Tool Operation (Part I); Kibbe: Machine Tool Practices; Porter: Machine Shop Operations and Setups	Ohio: Machine Trades I, Drilling Machine Work Assignment Sheet #10
MS-11 Identifying and using drill grinding machines		Burghardt: Machine Tool Operation (Part I); Kibbe: Machine Tool Practices; Porter: Machine Shop Operations and Setups	Ohio: Machine Trades I, Drilling Machine Work Assignment Sheet #11
MS-12 Identifying machine reamers	Bergwall: #505-5, "Bench Metalwork" (FS); Prentice-Hall: #XF929, "Machine Shop: Drill Press" (FS)	Burghardt: Machine Tool Operation (Part I); Kibbe: Machine Tool Practices; Porter: Machine Shop Operations and Setups	Ohio: Machine Trades I, Drilling Machine Work Assignment Sheet #12

CURRICULUM AREA: Metals Cluster (Machine Shop)

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audiovisuals	Textbooks	Student Materials
MS-13 Machine reaming	Bergwall: #505-5, "Bench Metalwork" (FS); Prentice-Hall: #XF929, "Machine Shop: Drill Press" (FS)	Burghardt: Machine Tool Operation (Part I); Kibbe: Machine Tool Practices; Porter: Machine Shop Operations and Setups	Ohio: Machine Trades I, Drilling Machine Work Assignment Sheet #13
MS-14 Identifying principles of boring and counterboring	Prentice-Hall: #XF929, "Machine Shop: Drill Press" (FS)	Burghardt: Machine Tool Operation (Part I); Kibbe: Machine Tool Practices; Porter: Machine Shop Operations and Setups	Ohio: Machine Trades I, Drilling Machine Work Assignment Sheet #14
MS-15 Spot facing	Prentice-Hall: #XF929, "Machine Shop: Drill Press" (FS)	Burghardt: Machine Tool Operation (Part I); Kibbe: Machine Tool Practices; Porter: Machine Shop Operations and Setups	Ohio: Machine Trades I, Drilling Machine Work Assignment Sheet #15
MS-16 Counter sinking and center drilling	Prentice-Hall: #XF929, "Machine Shop: Drill Press" (FS)	Burghardt: Machine Tool Operation (Part I); Kibbe: Machine Tool Practices; Porter: Machine Shop Operations and Setups	Ohio: Machine Trades I, Drilling Machine Work Assignment Sheet #16
MS-17 Identifying power cut-off saws		Burghardt: Machine Tool Operation (Part I); Porter: Machine Shop Operations and Setups	Ohio: Machine Trades I, Power Saw Work Assignment Sheet #1
MS-18 Identifying power saw safety		Burghardt: Machine Tool Operation (Part I); Kibbe: Machine Tool Practices	Ohio: Machine Trades I, Power Saw Work Assignment Sheet #2

CURRICULUM AREA: Metals Cluster (Machine Shop)

TASK LISTING		INSTRUCTIONAL MATERIAL REFERENCES		
		Audiovisuals	Textbooks	Student Materials
MS-19	Identifying and using work holding devices on the power cut-off saw		Burghardt: Machine Tool Operation (Part I); Kibbe: Machine Tool Practices	Ohio: Machine Trades I, Power Saw Work Assignment Sheet #3
MS-20	Identifying, selecting, mounting and maintaining saw blades		Burghardt: Machine Tool Operation (Part I); Kibbe: Machine Tool Practices; Porter: Machine Shop Operations and Setups	Ohio: Machine Trades I, Power Saw Work Assignment Sheet #4
MS-21	Identifying speeds, feeds and coolants for power cut-off saws	Bergwall: #505-2, "Bench Metalwork" (FS)	Burghardt: Machine Tool Operation (Part I); Kibbe: Machine Tool Practices	Ohio: Machine Trades I, Power Saw Work Assignment Sheet #6
MS-22	Using the power cut-off for straight and angular sawing	Bergwall: #505-2, "Bench Metalwork" (FS)	Burghardt: Machine Tool Operation (Part I); Kibbe: Machine Tool Practices	Ohio: Machine Trades I, Power Saw Work Assignment Sheet #6
MS-23	Identifying the metal band saw	Bergwall: #505-2, "Bench Metalwork" (FS)	Burghardt: Machine Tool Operation (Part II); Kibbe: Machine Tool Practices	Ohio: Machine Trades I, Power Saw Work Assignment Sheet #7
MS-24	Identifying coolants and lubricating agents for band saws	Bergwall: #505-2, "Bench Metalwork" (FS)	Burghardt: Machine Tool Operation (Part II); Kibbe: Machine Tool Practices	Ohio: Machine Trades I, Power Saw Work Assignment Sheet #8
MS-25	Choosing saw blades for the metal band saw	Bergwall: #505-2, "Bench Metalwork" (FS)	Burghardt: Machine Tool Operation (Part II); Kibbe: Machine Tool Practices	Ohio: Machine Trades I, Power Saw Work Assignment Sheet #9

CURRICULUM AREA: Metals Cluster (Machine Shop)

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audiovisuals	Textbooks	Student Materials
MS-26 Calculating feeds and speeds for metal band saw	Bergwall: #505-2, "Bench Metalwork" (FS)	Burghardt: Machine Tool Operation (Part II); Kibbe: Machine Tool Practices	Ohio: Machine Trades I, Power Saw Work Assignment Sheet #10
MS-27 Identifying lathe safety	Bergwall: #514-5, "Metal Shop Safety" (FS)	Burghardt: Machine Tool Operation (Part I); Kibbe: Machine Tool Practices; Porter: Machine Shop Operations and Setups	Georgia: Metal Fabrication Cluster, EL-2; Ohio: Machine Trades I, Engine Lathe Work Assignment Sheet #1
MS-28 Identifying lathes	Bergwall: #501-1, "The Lathe Explained" (FS); Prentice-Hall: #XF928, "Machine Shop: Engine Lathe" (FS)	Burghardt: Machine Tool Operation (Part I); Kibbe: Machine Tool Practices; Porter: Machine Shop Operations and Setups	Georgia: Metal Fabrication Cluster, EL-1, EL-3; Ohio: Machine Trades I, Drilling Machine Work Assignment Sheet #1
MS-29 Identifying work holding devices	Bergwall: #501-2, "The Lathe Explained" (FS); Prentice-Hall: #XF928, "Machine Shop: Engine Lathe" (FS)	Burghardt: Machine Tool Operation (Part I); Kibbe: Machine Tool Practices; Porter: Machine Shop Operations and Setups	Georgia: Metal Fabrication Cluster, BLO-1, OLO-12; Ohio: Machine Trades I, Engine Lathe Work Assignment Sheet #3
MS-30 Identifying cutting tools	Bergwall: #501-3, "The Lathe Explained" (FS); Prentice-Hall: #XF928, "Machine Shop: Engine Lathe" (FS)	Burghardt: Machine Tool Operation (Part I); Kibbe: Machine Tool Practices; Porter: Machine Shop Operations and Setups	Georgia: Metal Fabrication Cluster, GLT-1 through GLT-4; Ohio: Machine Trades I, Engine Lathe Work Assignment Sheet #4 and #5; Machine Shop Training Course, Vol. I
MS-31 Identifying measuring tools	Bergwall: #503, "Measuring Tools" (FS)	Burghardt: Machine Tool Operation (Part I); Kibbe: Machine Tool Practices; Porter: Machine Shop Operations and Setups	Georgia: Metal Fabrication Cluster, M-1 through M2; Ohio: Machine Trades I, Engine Lathe Work Assignment Sheet #6; Machine Shop Training Course, Vol. I

CURRICULUM AREA: Metals Cluster (Machine Shop)

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audiovisuals	Textbooks	Student Materials
MS-32 Identifying lathe attachments	Bergwall: #501-3, "The Lathe Explained" (FS); Prentice-Hall: #XF928, "Machine Shop: Engine Lathe" (FS)	Burghardt: Machine Tool Operation (Part I); Kibbe: Machine Tool Practices; Porter: Machine Shop Operations and Setups	Ohio: Machine Trades I, Engine Lathe Work Assignment Sheet #7
MS-33 Calculating cutting feeds and speeds on the lathe	Bergwall: #501-2, "The Lathe Explained" (FS); Prentice-Hall: #XF928, "Machine Shop: Engine Lathe" (FS)	Burghardt: Machine Tool Operation (Part I); Kibbe: Machine Tool Practices; Porter: Machine Shop Operations and Setups	Ohio: Machine Trades I, Engine Lathe Work Assignment Sheet #8; Machine Shop Training Course, Vol. I
MS-34 Determining RPM	Bergwall: #501-2, "The Lathe Explained" (FS); Prentice-Hall: #XF928, "Machine Shop: Engine Lathe" (FS)	Burghardt: Machine Tool Operation (Part I); Kibbe: Machine Tool Practices; Porter: Machine Shop Operations and Setups	Ohio: Machine Trades I, Engine Lathe Work Assignment Sheet #9; Machine Shop Training Course, Vol. I
MS-35 Center stock	Bergwall: #501-2, "The Lathe Explained" (FS); Prentice-Hall: #XF928, "Machine Shop: Engine Lathe" (FS)	Burghardt: Machine Tool Operation (Part I); Kibbe: Machine Tool Practices; Porter: Machine Shop Operations and Setups	Georgia: Metal Fabrication Cluster, BLO-5; Ohio: Machine Trades I, Engine Lathe Work Assignment Sheet #10; Machine Shop Training Course, Vol. I
MS-36 Identifying principles of facing	Bergwall: #501-4, "The Lathe Explained" (FS); Prentice-Hall: #XF928, "Machine Shop: Engine Lathe" (FS)	Burghardt: Machine Tool Operation (Part I); Kibbe: Machine Tool Practices; Porter: Machine Shop Operations and Setups	Georgia: Metal Fabrication Cluster, BLO-4; Ohio: Machine Trades I, Engine Lathe Work Assignment Sheet #11; Machine Shop Training Course, Vol. I

CURRICULUM AREA: Metals Cluster (Machine Shop)

TASK LISTING		INSTRUCTIONAL MATERIAL REFERENCES		
		Audiovisuals	Textbooks	Student Materials
MS-37	Identifying principles of straight turning and turning to shoulders	Bergwall: #501-4, "The Lathe Explained" (FS); Prentice-Hall: #XF928, "Machine Shop: Engine Lathe" (FS)	Burghardt: Machine Tool Operation (Part I); Kibbe: Machine Tool Practices; Porter: Machine Shop Operations and Setups	Georgia: Metal Fabrication Cluster, BLO-2, BLO-3; Ohio: Machine Trades I, Engine Lathe Work Assignment Sheet #12; Machine Shop Training Course, Vol. I
MS-38	Identifying chucks	Bergwall: #501-4, "The Lathe Explained" (FS); Prentice-Hall: #XF928, "Machine Shop: Engine Lathe" (FS)	Burghardt: Machine Tool Operation (Part I); Kibbe: Machine Tool Practices; Porter: Machine Shop Operations and Setups	Georgia: Metal Fabrication Cluster, BLO-1; Ohio: Machine Trades I, Engine Lathe Work Assignment Sheet #13; Machine Shop Training Course, Vol. I
MS-39	Form turning	Bergwall: #501, "The Lathe Explained" (FS); Prentice-Hall: #XF928, "Machine Shop: Engine Lathe" (FS)	Burghardt: Machine Tool Operation (Part I); Kibbe: Machine Tool Practices	Ohio: Machine Trades I, Engine Lathe Work Assignment Sheet #14; Machine Shop Training Course, Vol. I
MS-40	Identifying face plate work	Bergwall: #501-4, "The Lathe Explained" (FS); Prentice-Hall: #XF928, "Machine Shop: Engine Lathe" (FS)	Burghardt: Machine Tool Operation (Part I); Kibbe: Machine Tool Practices; Porter: Machine Shop Operations and Setups	Ohio: Machine Trades I, Engine Lathe Work Assignment Sheet #16; Machine Shop Training Course, Vol. I; Georgia: Metal Fabrication Cluster, OLO-10, OLO-11
MS-41	Using draw-in collets	Bergwall: #501-3, "The Lathe Explained" (FS); Prentice-Hall: #XF928, "Machine Shop: Engine Lathe" (FS)	Burghardt: Machine Tool Operation (Part I); Kibbe: Machine Tool Practices; Porter: Machine Shop Operations and Setups	Georgia: Metal Fabrication Cluster, OLO-12; Ohio: Machine Trades I, Engine Lathe Work Assignment Sheet #17; Machine Shop Training Course, Vol. I

CURRICULUM AREA: Metals Cluster (Machine Shop)

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audiovisuals	Textbooks	Student Materials
MS-42 Identifying principles of drilling	Bergwall: #505-5, "Bench Metalwork" (FS)	Burghardt: Machine Tool Operation (Part I); Kibbe: Machine Tool Practices; Porter: Machine Shop Operations and Setups	Georgia: Metal Fabrication Cluster, OLO-1; Ohio: Machine Trades I, Engine Lathe Work Assignment Sheet #18; Machine Shop Training Course, Vol. I
MS-43 Identifying machine reamers	Bergwall: #505-5, "Bench Metalwork" (FS)	Burghardt: Machine Tool Operation (Part I); Kibbe: Machine Tool Practices; Porter: Machine Shop Operations and Setups	Ohio: Machine Trades I, Engine Lathe Work Assignment Sheet #19; Machine Shop Training Course, Vol. I
MS-44 Reaming on the engine lathe	Bergwall: #505-5, "Bench Metalwork" (FS)	Burghardt: Machine Tool Operation (Part I); Kibbe: Machine Tool Practices; Porter: Machine Shop Operations and Setups	Georgia: Metal Fabrication Cluster, OLO-9; Ohio: Machine Trades I, Engine Lathe Work Assignment Sheet #20; Machine Shop Training Course, Vol. I
MS-45 Boring on the engine lathe	Bergwall: #505-5, "Bench Metalwork" (FS); Prentice-Hall: #XF928, "Machine Shop: Engine Lathe" (FS)	Burghardt: Machine Tool Operation (Part I); Kibbe: Machine Tool Practices; Porter: Machine Shop Operations and Setups	Georgia: Metal Fabrication Cluster, OLO-6; Ohio: Machine Trades I, Engine Lathe Work Assignment Sheet #21; Machine Shop Training Course, Vol. I
MS-46 Identifying and using mandrels	Bergwall: #505-5, "Bench Metalwork" (FS); Prentice-Hall: #XF928, "Machine Shop: Engine Lathe" (FS)	Burghardt: Machine Tool Operation (Part I); Kibbe: Machine Tool Practices; Porter: Machine Shop Operations and Setups	Ohio: Machine Trades I, Engine Lathe Work Assignment Sheet #22; Machine Shop Training Course, Vol. I

CURRICULUM AREA: Metals Cluster (Machine Shop)

TASK LISTING		INSTRUCTIONAL MATERIAL REFERENCES		
		Audiovisuals	Textbooks	Student Materials
MS-47	Knurling on the engine lathe	Prentice-Hall: #XF928, "Machine Shop: Engine Lathe" (FS)	Burghardt: Machine Tool Operation (Part I); Kibbe: Machine Tool Practices; Porter: Machine Shop Operations and Setups	Georgia: Metal Fabrication Cluster, LO-1; Ohio: Machine Trades I, Engine Lathe Work Assignment Sheet #23; Machine Shop Training Course, Vol. I
MS-48	Cutting off on the engine lathe		Burghardt: Machine Tool Operation (Part I); Kibbe: Machine Tool Practices; Porter: Machine Shop Operations and Setups	Ohio: Machine Trades I, Engine Lathe Work Assignment Sheet #24; Machine Shop Training Course, Vol. I
MS-49	Identifying thread cutting devices	Bergwall: #501-6, "The Lathe Explained" (FS); Prentice-Hall: #XF928, "Machine Shop: Engine Lathe" (FS)	Burghardt: Machine Tool Operation (Part I); Kibbe: Machine Tool Practices; Porter: Machine Shop Operations and Setups	Ohio: Machine Trades I, Engine Lathe Work Assignment Sheet #25; Machine Shop Training Course, Vol. I
MS-50	Identifying the parts of a thread		Burghardt: Machine Tool Operation (Part I); Kibbe: Machine Tool Practices	Ohio: Machine Trades I, Engine Lathe Work Assignment Sheet #26; Machine Shop Training Course, Vol. I
MS-51	Identifying American National thread standards		Kibbe: Machine Tool Practices	Ohio: Machine Trades I, Engine Lathe Work Assignment Sheet #27; Machine Shop Training Course, Vol. I
MS-52	Computing American National thread form		Burghardt: Machine Tool Operation	Ohio: Machine Trades I, Engine Lathe Work Assignment Sheet #28; Machine Shop Training Course, Vol. I

CURRICULUM AREA: Metals Cluster (Machine Shop)

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audiovisuals	Textbooks	Student Materials
MS-53 Computing sharp V-thread formulas		Burghardt: Machine Tool Operation (Part I); Kibbe: Machine Tool Practices	Ohio: Machine Trades I, Engine Lathe Work Assignment Sheet #29; Machine Shop Training Course, Vol. I
MS-54 Identifying Acme threads		Burghardt: Machine Tool Operation (Part I); Kibbe: Machine Tool Practices; Porter: Machine Shop Operations and Setups	Ohio: Machine Trades I, Engine Lathe Work Assignment Sheet #30; Machine Shop Training Course, Vol. I
MS-55 Using the Acme tap	Bergwall: #505-5, "Bench Metalwork" (FS)	Burghardt: Machine Tool Operation (Part I); Kibbe: Machine Tool Practices; Porter: Machine Shop Operations and Setups	Ohio: Machine Trades I, Engine Lathe Work Assignment Sheet #31
MS-56 Identifying square threads		Burghardt: Machine Tool Operation (Part I); Kibbe: Machine Tool Practices; Porter: Machine Shop Operations and Setups	Ohio: Machine Trades I, Engine Lathe Work Assignment Sheet #32; Machine Shop Training Course, Vol. I
MS-57 Identifying classes of fits of screw threads		Burghardt: Machine Tool Operation (Part I); Kibbe: Machine Tool Practices; Porter: Machine Shop Operations and Setups	Ohio: Machine Trades I, Engine Lathe Work Assignment Sheet #33
MS-58 Using thread gages	Bergwall: #501-6, "The Lathe Explained" (FS); Prentice-Hall: #XF928, "Machine Shop: Engine Lathe" (FS)	Burghardt: Machine Tool Operation (Part I); Kibbe: Machine Tool Practices; Porter: Machine Shop Operations and Setups	Ohio: Machine Trades I, Engine Lathe Work Assignment Sheet #34

CURRICULUM AREA: Metals Cluster (Machine Shop)

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audiovisuals	Textbooks	Student Materials
MS-59 Using a thread micrometer	Bergwall: #501-6, "The Lathe Explained" (FS); Prentice-Hall: #XF928, "Machine Shop: Engine Lathe" (FS)	Burghardt: Machine Tool Operation (Part I); Kibbe: Machine Tool Practices; Porter: Machine Shop Operations and Setups	Ohio: Machine Trades I, Engine Lathe Work Assignment Sheet #35; Machine Shop Training Course, Vol. I
MS-60 Measuring threads with the three wire method	Bergwall: #501-6, "The Lathe Explained" (FS); Prentice-Hall: #XF928, "Machine Shop: Engine Lathe" (FS)	Burghardt: Machine Tool Operation (Part I); Kibbe: Machine Tool Practices; Porter: Machine Shop Operations and Setups	Ohio: Machine Trades I, Engine Lathe Work Assignment Sheet #36; Machine Shop Training Course, Vol. I
MS-61 Cutting threads with an even geared lathe	Bergwall: #501-6, "The Lathe Explained" (FS); Prentice-Hall: #XF928, "Machine Shop: Engine Lathe" (FS)	Kibbe: Machine Tool Practices	Georgia: Metal Fabrication Cluster, LO-5, LO-6; Ohio: Machine Trades I, Engine Lathe Work Assignment Sheet #37; Machine Shop Training Course, Vol. I; Georgia: Metals Fabrication Mathematics
MS-62 Cutting threads on a lathe which is not even geared	Bergwall: #501-6, "The Lathe Explained" (FS); Prentice-Hall: #XF928, "Machine Shop: Engine Lathe" (FS)	Kibbe: Machine Tool Practices	Ohio: Machine Trades I, Engine Lathe Work Assignment Sheet #38; Georgia: Metals Fabrication Mathematics
MS-63 Cutting threads on a quick-change gear lathe	Bergwall: #501-6, "The Lathe Explained" (FS); Prentice-Hall: #XF928, "Machine Shop: Engine Lathe" (FS)	Burghardt: Machine Tool Operation (Part I); Kibbe: Machine Tool Practices	Ohio: Machine Trades I, Engine Lathe Work Assignment Sheet #40; Machine Shop Training Course, Vol. I

CURRICULUM AREA: Metals Cluster (Machine Shop)

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audiovisuals	Textbooks	Student Materials
MS-64 Identifying multiple lead screw threads	Bergwall: #501-6, "The Lathe Explained" (FS); Prentice-Hall: #XF928, "Machine Shop: Engine Lathe" (FS)	Burghardt: Machine Tool Operation (Part I); Kibbe: Machine Tool Practices; Porter: Machine Shop Operations and Setups	Ohio: Machine Trades I, Engine Lathe Work Assignment Sheet #41
MS-65 Cutting left hand threads	Bergwall: #501-6, "The Lathe Explained" (FS); Prentice-Hall: #XF928, "Machine Shop: Engine Lathe" (FS)	Burghardt: Machine Tool Operation (Part I); Kibbe: Machine Tool Practices; Porter: Machine Shop Operations and Setups	Ohio: Machine Trades I, Engine Lathe Work Assignment Sheet #42
MS-66 Determining a tap drill size	Bergwall: #501-6, "The Lathe Explained" (FS); Prentice-Hall: #XF928, "Machine Shop: Engine Lathe" (FS)	Burghardt: Machine Tool Operation (Part I); Kibbe: Machine Tool Practices; Porter: Machine Shop Operations and Setups	Ohio: Machine Trades I, Engine Lathe Work Assignment Sheet #43; Machine Shop Training Course, Vol. II
MS-67 Cutting internal threads and tapping	Bergwall: #501-6, "The Lathe Explained" (FS); Prentice-Hall: #XF928, "Machine Shop: Engine Lathe" (FS)	Burghardt: Machine Tool Operation (Part I); Kibbe: Machine Tool Practices; Porter: Machine Shop Operations and Setups	Georgia: Metal Fabrication Cluster, OLO-2; Ohio: Machine Trades I, Engine Lathe Work Assignment Sheet #44
MS-68 Identifying principles of taper turning	Bergwall: #505-5, "The Lathe Explained" (FS); Prentice-Hall: #XF928, "Machine Shop: Engine Lathe" (FS)	Kibbe: Machine Tool Practices	Georgia: Metal Fabrication Cluster, LO-3; Ohio: Machine Trades I, Engine Lathe Work Assignment Sheet #45; Machine Shop Training Course, Vol. I

CURRICULUM AREA: Metals Cluster (Machine Shop)

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audiovisuals	Textbooks	Student Materials
MS-69 Computing tapers	Bergwall: #505-6, "The Lathe Explained" (FS); Prentice-Hall: #XF928, "Machine Shop: Engine Lathe" (FS)	Burghardt: Machine Tool Operation (Part I); Kibbe: Machine Tool Practices; Porter: Machine Shop Operations and Setups	Ohio: Machine Trades I, Engine Lathe Work Assignment Sheet #46; Machine Shop Training Course, Vol. I
MS-70 Measuring short tapers	Bergwall: #505-5, "The Lathe Explained" (FS); Prentice-Hall: #XF928, "Machine Shop: Engine Lathe" (FS)	Burghardt: Machine Tool Operation (Part I); Kibbe: Machine Tool Practices; Porter: Machine Shop Operations and Setups	Ohio: Machine Trades I, Engine Lathe Work Assignment Sheet #47; Machine Shop Training Course, Vol. I
MS-71 Gaging inside and outside tapers	Bergwall: #505-5, "The Lathe Explained" (FS); Prentice-Hall: #XF928, "Machine Shop: Engine Lathe" (FS)	Burghardt: Machine Tool Operation (Part I); Kibbe: Machine Tool Practices; Porter: Machine Shop Operations and Setups	Ohio: Machine Trades I, Engine Lathe Work Assignment Sheet #48
MS-72 Tapering by the offset tailstock method	Bergwall: #505-3, "The Lathe Explained" (FS); Prentice-Hall: #XF928, "Machine Shop: Engine Lathe" (FS)	Burghardt: Machine Tool Operation (Part I); Kibbe: Machine Tool Practices; Porter: Machine Shop Operations and Setups	Georgia: Metal Fabrication Cluster, LO-7; Ohio: Machine Trades I, Engine Lathe Work Assignment Sheet #49; Machine Shop Training Course, Vol. I
MS-73 Cutting a taper with the compound rest	Bergwall: #505-5, "The Lathe Explained" (FS); Prentice-Hall: #XF938, "Machine Shop: Engine Lathe" (FS)	Burghardt: Machine Tool Operation (Part I); Kibbe: Machine Tool Practices; Porter: Machine Shop Operations and Setups	Ohio: Machine Trades I, Engine Lathe Work Assignment Sheet #50; Machine Shop Training Course, Vol. I

CURRICULUM AREA: Metals Cluster (Machine Shop)

TASK LISTING		INSTRUCTIONAL MATERIAL REFERENCES		
		Audiovisuals	Textbooks	Student Materials
MS-74	Cutting a taper with the taper attachment	Bergwall: #505-5, "The Lathe Explained" (FS); Prentice-Hall: #XF928, "Machine Shop: Engine Lathe" (FS)	Burghardt: Machine Tool Operation (Part I); Kibbe: Machine Tool Practices; Porter: Machine Shop Operations and Setups	Georgia: Metal Fabrication Cluster, LO-4; Ohio: Machine Trades I, Engine Lathe Work Assignment Sheet #51
MS-75	Boring or turning internal tapers	Bergwall: #505-5, "The Lathe Explained" (FS); Prentice-Hall: #XF928, "Machine Shop: Engine Lathe" (FS)	Burghardt: Machine Tool Operation (Part I); Kibbe: Machine Tool Practices	Ohio: Machine Trades I, Engine Lathe Work Assignment Sheet #52
MS-76	Identifying coolants and cutting components	Prentice-Hall: #XF928, "Machine Shop: Engine Lathe" (FS)	Burghardt: Machine Tool Operation (Part I); Kibbe: Machine Tool Practices; Porter: Machine Shop Operations and Setups	Ohio: Machine Trades I, Engine Lathe Work Assignment Sheet #53; Machine Shop Training Course, Vol. I
MS-77	Identifying lubricants	Prentice-Hall: #XF928, "Machine Shop: Engine Lathe" (FS)	Burghardt: Machine Tool Operation (Part I); Kibbe: Machine Tool Practices	Ohio: Machine Trades I, Engine Lathe Work Assignment Sheet #54
MS-78	Identifying types, sizes, construction, specifications, nomenclature and range of work for milling machines	Bergwall: #502-1, "Milling Machine Explained" (FS); Prentice-Hall: #VD919-1, "Machine Shop: Horizontal Milling Machine" (FS)	Burghardt: Machine Tool Operation (Part II); Kibbe: Machine Tool Practices; McCarthy: Machine Tool Technology; Porter: Machine Shop Operations and Setups	Ohio: Machine Trades II, Milling Assignment Sheets #1, 8; Georgia: Metal Fabrication Cluster, VM-1, VM-2, VM-3, HM-1, HM-2, HM-3

CURRICULUM AREA: Metals Cluster (Machine Shop)

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audiovisuals	Textbooks	Student Materials
MS-79 Identifying milling machine work holding devices and their functions	Bergwall: #502-2, "Milling Machine Explained" (FS); Prentice-Hall: #VD919-2, "Machine Shop: Horizontal Milling Machine" (FS); #VD920-1, "Machine Shop: Vertical Milling Machine" (FS)	Burghardt: Machine Tool Operation (Part II); Kibbe: Machine Tool Practices; Walker: Machining Fundamentals; Porter: Machine Shop Operations and Setups	Ohio: Machine Trades II, Milling Assignment Sheet #4; Georgia: Metal Fabrication Cluster, VM-4, VM-6, HM-4, HM-6
MS-80 Identifying, selecting and aligning milling machine attachments	Bergwall: #502-3, 4, 5, "Milling Machine Explained" (FS); Prentice-Hall: #VD-919-5, "Machine Shop: Horizontal Milling Machine" (FS); #VD920-4, "Machine Shop: Vertical Milling Machine" (FS)	Burghardt: Machine Tool Operation (Part II); Kibbe: Machine Tool Practices; Walker: Machining Fundamentals; Porter: Machine Shop Operations and Setups	Ohio: Machine Trades II, Milling Assignment Sheet #5
MS-81 Selecting and setting up milling machine cutters and holders	Bergwall: #502-2, "Milling Machine Explained" (FS); Prentice-Hall: #XF919-2, "Machine Shop: Horizontal Milling Machine" (FS)	Burghardt: Machine Tool Operation (Part II); Kibbe: Machine Tool Practices; Walker: Machining Fundamentals; Porter: Machine Shop Operations and Setups	Ohio: Machine Trades II, Milling Assignment Sheet #6; Georgia: Metal Fabrication Cluster, VM-7, HM-7
MS-82 Calculating cutting speeds and feeds for milling machine work	Prentice-Hall: #VD919-3, "Machine Shop: Horizontal Milling Machine" (FS)	Burghardt: Machine Tool Operation (Part II); Kibbe: Machine Tool Practices; Walker: Machining Fundamentals; Porter: Machine Shop Operations and Setups	Ohio: Machine Trades II, Milling Assignment Sheet #7; Georgia: Metal Fabrication Cluster, VM-5, HM-5

CURRICULUM AREA: Metals Cluster (Machine Shop)

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audiovisuals	Textbooks	Student Materials
MS-83 Performing a plain milling operation	Bergwall: #502-4, "Milling Machine Explained" (FS); Prentice-Hall: #VD919-3, "Machine Shop: Horizontal Milling Machine"; #VD920-2, "Machine Shop: Vertical Milling Machine" (FS)	Burghardt: Machine Tool Operation (Part II); Kibbe: Machine Tool Practices; Walker: Machining Fundamentals; Porter: Machine Shop Operations and Setups	Ohio: Machine Trades II, Milling Assignment Sheet #9; Georgia: Metal Fabrication Cluster, HM-10
MS-84 Performing a face milling operation	Prentice-Hall: #XF919-3, "Machine Shop: Horizontal Milling Machine" (FS)	Burghardt: Machine Tool Operation (Part II); Kibbe: Machine Tool Practices; Walker: Machining Fundamentals; Porter: Machine Shop Operation and Setups	Ohio: Machine Trades II, Milling Assignment Sheet #10; Georgia: Metal Fabrication Cluster, VM-8, HM-8
MS-85 Performing a side milling operation	Prentice-Hall: #VD920-2, "Machine Shop: Vertical Milling Machine" (FS)	Burghardt: Machine Tool Operation (Part II); Kibbe: Machine Tool Practices; McCarthy: Machine Tool Technology; Porter: Machine Shop Operations and Setups	Ohio: Machine Trades II, Milling Assignment Sheet #11
MS-86 Performing a form milling operation		Burghardt: Machine Tool Operation (Part II); Kibbe: Machine Tool Practices; McCarthy: Machine Tool Technology; Porter: Machine Shop Operations and Setups	Ohio: Machine Trades II, Milling Assignment Sheet #12

CURRICULUM AREA: Metals Cluster (Machine Shop)

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audiovisuals	Textbooks	Student Materials
MS-87 Performing an angular milling operation	Prentice-Hall: #VD920-4, "Machine Shop: Vertical Milling Machine" (FS)	Burghardt: Machine Tool Operation (Part II); Kibbe: Machine Tool Practices; Porter: Machine Shop Operations and Setups	Ohio: Machine Trades II, Milling Assignment Sheet #13
MS-88 Performing an end milling operation	Bergwall: #502-3, "Milling Machine Explained" (FS)	Burghardt: Machine Tool Operation (Part II); Kibbe: Machine Tool Practices; Porter: Machine Tool Operations and Setups	Ohio: Machine Trades II, Milling Assignment Sheet #25; Georgia: Metal Fabrication Cluster, HM-10
MS-89 Drilling, boring and reaming with the milling machine		Burghardt: Machine Tool Operation (Part II); Kibbe: Machine Tool Practices; Walker: Machining Fundamentals	Ohio: Machine Trades II, Milling Assignment Sheet #26; Georgia: Metal Fabrication Cluster, VM-9
MS-90 Performing sawing, slitting and cutting off operations with the milling machine	Prentice-Hall: #VD919-5, "Machine Shop: Horizontal Milling Machine" (FS)	Burghardt: Machine Tool Operation (Part II); Kibbe: Machine Tool Practices; Porter: Machine Shop Operations and Setups; Walker: Machining Fundamentals	Ohio: Machine Trades II, Milling Assignment Sheet #17
MS-91 Performing keyseating and T-slot milling operations	Bergwall: #502-3, "Milling Machine Explained" (FS)	Burghardt: Machine Tool Operation (Part II); Kibbe: Machine Tool Practices; Porter: Machine Shop Operations and Setups; Walker: Machining Fundamentals	Ohio: Machine Trades II, Milling Assignment Sheet #18; Georgia: Metal Fabrication Cluster, VM-10

CURRICULUM AREA: Metals Cluster (Machine Shop)

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Aidiovisuals	Textbooks	Student Materials
MS-92 Performing indexing operations	Bergwall: #502-5, "Milling Machine Explained" (FS); Prentice-Hall: #VD919-4, "Machine Shop: Horizontal Milling Machine" (FS)	Burghardt: Machine Tool Operation (Part II); Kibbe: Machine Tool Practices; Porter: Machine Shop Operations and Setups; Walker: Machining Fundamentals	Ohio: Machine Trades II, Milling Assignment Sheet #19, 20, 21
MS-93 Performing circular milling operations	Bergwall: #502-3, "Milling Machine Explained" (FS)	Burghardt: Machine Tool Operation (Part II); Kibbe: Machine Tool Practices	Ohio: Machine Trades II, Milling Assignment Sheet #22
MS-94 Performing graduating and marking operations	Bergwall: #502-5, 6, "Milling Machine Explained" (FS)	Burghardt: Machine Tool Operation (Part II); Kibbe: Machine Tool Practices	Ohio: Machine Trades II, Milling Assignment Sheet
MS-95 Performing profiling		Burghardt: Machine Tool Operation (Part II); Kibbe: Machine Tool Practices	
MS-96 Maintaining and caring for the milling machine		Burghardt: Machine Tool Operation (Part II); Kibbe: Machine Tool Practices; Porter: Machine Shop Operations and Setups	Ohio: Machine Trades II, Milling Assignment Sheet #2; Georgia: Metal Fabrication Cluster, HM-11

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AUDIOVISUALS

AAVIM	Slide/tapes
Bergwall Productions, Inc.	Filmstrips
Career Aids, Inc.	Filmstrips
DCA Educational Products	Transparencies, 8mm Film Loops
Delmar	Transparencies
Prentice-Hall Media	Filmstrips
University of Georgia Vocational Education Materials Center	Slide/tapes

Additional audiovisual resources are listed in Index to Vocational and Technical Education (Multimedia) and are available from:

National Information Center for Educational Media
(NICEM)
University of Southern California
University Park
Los Angeles, CA 90007

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APPENDIX B

Special Needs

WORKING WITH SPECIAL NEEDS STUDENTS*

Introduction

Special needs population students are those who are designated as handicapped or disadvantaged. The 1976 vocational education amendments define handicapped individuals as:

> Persons who are mentally retarded, hard of hearing, deaf, speech impaired, visually handicapped, seriously emotionally disturbed, orthopedically impaired, health impaired, or persons with other specific disabilities, who by reason thereof require special education and related services and who cannot succeed in the regular vocational education programs.

In those same amendments disadvantaged persons are defined as:

> Persons (other than handicapped persons) who have academic or economic disadvantages and who require special services, assistance or programs in order to enable them to succeed in vocational education programs.

Federal legislation requires that these special needs population students be given an opportunity to function in regular vocational education programs (essentially, this is what is meant by the term mainstreaming). This section provides information on how such students are identified and how they can be mainstreamed into regular vocational education environments.

Figure One presents a conceptual model depicting various activities of the process in identifying and mainstreaming special needs students in vocational education. These activities

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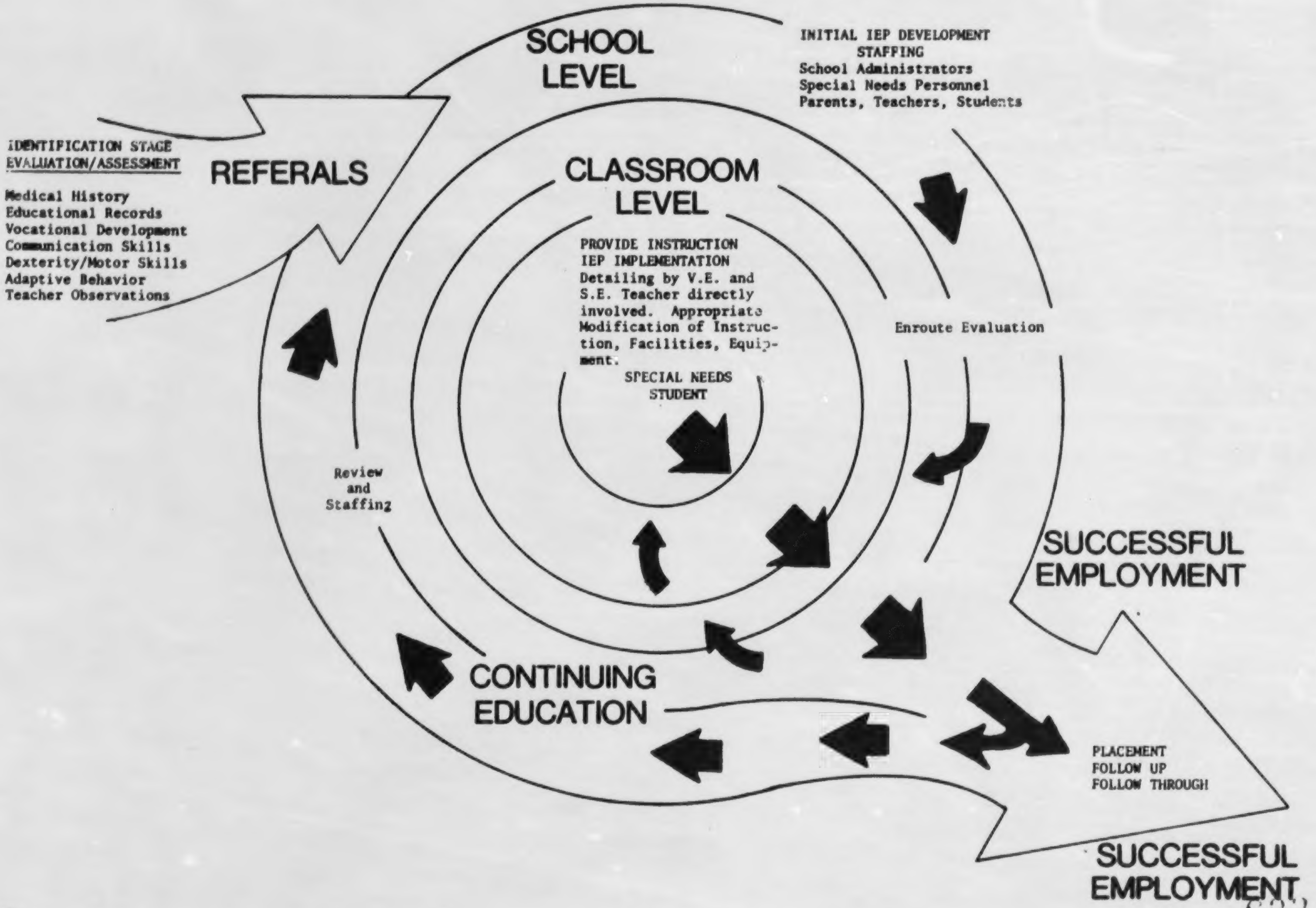
THE CONCEPT OF MAINSTREAMING


SCHOOL LEVEL
INITIAL IEP DEVELOPMENT
STAFFING
School Administrators
Special Needs Personnel
Parents, Teachers, Students
IDENTIFICATION STAGE
EVALUATION/ASSESSMENT
Medical History
Educational Records
Vocational Development
Communication Skills
Dexterity/Motor Skills
Adaptive Behavior
Teacher Observations
REFERALS
CLASSROOM LEVEL
PROVIDE INSTRUCTION
IEP IMPLEMENTATION
Detailing by V.E. and S.E. Teacher directly involved. Appropriate Modification of Instruction, Facilities, Equipment.
SPECIAL NEEDS STUDENT
Enroute Evaluation
Review and Staffing
SUCCESSFUL EMPLOYMENT
CONTINUING EDUCATION
PLACEMENT
FOLLOW UP
FOLLOW THROUGH
SUCCESSFUL EMPLOYMENT

are conducted at three levels: the system level, the school level and the classroom level. All three levels must work together if implementation of the process is to be effective.

Identification of the Special Needs Student

Through a variety of pre-testing procedures, special needs students are identified and their potentials are evaluated at the system level. This evaluation process consists of collecting and assessing the following data for each student:

- Medical History
- Educational Records
- Vocational Development
- Communication Skills
- Dexterity/Motor Skills
- Adaptive Behavior
- Teacher Observations

When this procedure has been completed, the system personnel refers the student to the appropriate school level personnel. As a part of the referral and school intake process an Individualized Educational Plan should be initiated.

> The Individualized Educational Plan (IEP) is exactly what its name implies--a plan for the education of a specific individual. The base content of the IEP is outlines in Public Law 94-142. According to that outline, the IEP must include at least the following information: (a) student's present level of functioning, (b) his/her long range instructional objectives, (c) his/her short-range instructional objectives and finally, (d) some criteria to determine that those objectives have been achieved.

Development of the Individual Education Plan

It would be very difficult to anticipate the exact kind or type of special needs students one might find in a Metals Cluster program at any one time. The terms disadvantaged and handicapped are really "catch-all" terms that indicate a wide assortment of problems that might occur in a student representing one of these populations. In addition to the lack of a specific definition and the fact that the typical vocational instructor has had very little preparation in working with these students, it becomes clear that you will need a basic plan to use in meeting their occupational preparation needs. The following steps can serve as your basic planning procedure for mainstreaming a special needs population student into your curriculum.

The first step occurs after you have been notified that a special needs student can profit from being in your vocational program. When you have received that notification, you should contact your vocational supervisor and ask for a detailed report of the student's *assessed* status. Note the word *assessed*; it is critical. Through a formal assessment status, appropriate school personnel should have identified the student's strengths and weaknesses as well as the specific handicapping conditions. After you have received the assessment information and understand it you are ready for Step Two.

Step Two, developing (or completing) the vocational aspects of the Individual Education Plan-IEP, is usually performed for handicapped students only; however, it has just as much merit for the disadvantaged. The IEP is a very useful tool. It should be considered the description of what you expect that student to be able to do when he or she completes your course and how you will provide the learning experiences to assure that those expected outcomes will be achieved. Be sure that you keep this IEP in a convenient place and *use it*.

The IEP is usually developed through group activities called staffings. Staffings* may be held as often as needed and can be used to modify the IEP as the student moves through the program. When a student is about to be mainstreamed into your curriculum, you must become involved in the staffing sessions that will develop the vocational aspects of the IEP. IT IS YOUR RIGHT AND YOUR DUTY, therefore, your being present during the staffings is imperative. The special education personnel can present the student's interest, strengths and limitations. However, only you, the vocational instructor, can relate these to your program. This means that the final statement of the job (DOT) and the task level (short term) objectives are primarily defined by you the vocational instructor.

In Step Three the IEP will first be used to suggest how the curriculum and/or the facilities can be modified to accommodate the special needs population student. Modifying the curriculum means that in most cased special adjustments will have to be made in the student materials and that special instructional strategies will need to be developed. When you say modify the curriculum you are not suggesting that the content be "watered down" - you are proposing alternate ways to teach the proper/required content. REMEMBER! ALL VOCATIONAL EDUCATION PROGRAMS ARE BASED ON REAL JOBS THAT HAVE THEIR OWN TASKS AND STANDARDS. AS FAR AS YOU ARE CONCERNED, YOU HAVE NO

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*At least one staffing per student is required annually. This will ensure that the student is progressing toward prescribed goals at an appropriate rate.

POWER TO CHANGE THESE. YOU ALSO CANNOT SUCCESSFULLY CREATE A WHOLE NEW JOB.

Modification of facilities and equipment is a concern when working with the phyically handicapped. Be reminded that by law your school building must already meet requirements of accessibility to all handicapped persons--especially those who are blind or are confined to wheelchairs. Your chief concern is to be sure that your classroom and laboratory will allow the handicapped students to be comfortable and above all to learn. You will also need to make certain modifications that will enable the handicapped students to properly and safely use the "tools and equipment of the trade". It is foolish to think that you would have a ready answer for all or any particular one of these physical handicaps--call on the experts. Vocational rehabilitation counselors and other staff have been concentrating on these problems for many years. They should be able to offer a number of positive suggestions. A combination of VR experience and instructor creativity can and has produced outstanding results.

As we think about curriculum modification it would help to review some general learning needs of these populations.

> The educationally mentally retarded will constitute a major population now entering vocational education. The key concept to remember in modifying the curriculum for this population is that they require much more detail in order to learn and they require a great deal more practice time. All curriculum modifications for these groups should be made by detailing each task or objective into its smallest parts and by providing for more and more practice.
>
> The hearing and visually impaired can be accommodated by common sense and the use of supporting resource personnel. Neither of these groups reads well or learns from reading

as a primary mode. This should be accounted for in modifying the curriculum, i.e., larger print, brail and recordings for the blind and captions on visual materials, seating arrangements, use of notes from a classmate, lower reading level textbooks, oral testing, and total communications for the deaf.

The orthopedically handicapped usually require attention to facilities and equipment. Beyond that, their learning needs are as varied as those of the normal population. Remember, some of these individuals will actually be highly gifted in their chosen field. Their major needs will be psychological and coping with the school environment.

The disadvantaged are physically and mentally capable of learning, but their background has not allowed them to fully develop the discipline and cognitive skills (i.e., vocabulary, math, etc.) required to master occupational preparation courses. They have also developed an anti-school attitude that complicate many efforts to modify the curriculum for them. Usually their success in the vocational program is contingent on either a good prevocational program or a supporting academic program.

Step Four requires that instructional strategies be selected. These strategies may be many and should be varied. They should reflect the best learning technique for a given student and his or her chosen occupation. Some examples of instructional strategies are discussed below.

Teacher demonstration: Simply show the student how the job is to be done in clear distinct steps.

Peer demonstration: This technique allows the instructor to use one of the advanced students to demonstrate a particular task in a step by step fashion. It is a flexible system. For example, you can use the peer demonstration to show each task step while you explain them to the students. When working with the mentally retarded, you will never have enough time to demonstrate a task as often as they may need to see it. In such situations, the well prepared advanced student can perform and explain the same demonstration several times.

Shadowing: Shadowing can be used in conjunction with demonstrations. By shadowing, the student is allowed to do exactly what the demonstrator does. This allows the student to learn in a see and do fashion. The student may shadow the instructor, an advanced peer or in some instances the worker on the job.

Job site visits: Job site visits offer the student an opportunity to see the work being done in its natural location. Students can develop a worker identity and a realistic view of how the tools, equipment and materials are brought together to produce the product.

Work group or team: By being a part of a work team, the student can learn the various roles in an occupation as having the opportunity to practice specific sets of skills under the tutelage of peers.

Individualized instruction: Appropriately prepared or adjusted individualized instruction is a big help in managing a class that contains a mixture of special needs population students and "norm group" students. Individualized instruction, no matter what the source, will require much developmental input from the instructor. In most all cases, however, the results are worth the effort.

Media: Many of the special needs populations require mediated instruction (i.e., hearing and visually impaired), however, the use of appropriate media enhances learning for all students. Media can range from a line drawing in an instructional module, to a video tape, to posters and charts. It can be instructor made or commercial. All that matters is that it exactly links to the objective.

Project Method: The value in using projects with special needs population students is that they help them mentally and physically unify all the parts into a uniform whole. Because of the detail required for them to learn, they need learning activities that relate all of the parts to the whole. The development of a product through an assigned project is an ideal integrating experience.

Simulations: Simulations meet a variety of instructional needs. One of the more important with special needs population students is providing the opportunity to develop proper safety concepts before actually working with the "live" equipment that could be dangerous to a careless student.

Role playing: Role playing is a part of several other instructional strategies. On its own, it is a very good procedure for developing the attitudes and values required of a successful worker-i.e., a sense of responsibility, the ability to take orders and follow directions, interpersonal skills and so on. It is a way to concentrate on developing good work habits and positive attitudes.

Peer instruction: Like peer demonstrations, peer instruction is able to multiply the instructor's available time. This allows individual students with specific needs to have more assistance. Peer instruction has values beyond expanding time; it is an excellent approach to learning. In almost every situation, both the peer teacher and the peer student profit from the exchange. In operation peer instruction is simply a matter of preparing and allowing one of the advanced students to teach small groups certain segments of a course.

Team teaching: As we have already noted, some special needs populations require a combination of vocational and special education presented in harmony. A team approach is the only way to meet that need. For team teaching to be effective, clarification of student needs (as defined by the IEP) and careful planning will be required.

Peer apprenticeships: The peer apprenticeship is an ideal way to induct the new special needs population student into the curriculum. By serving as the apprentice to an advanced student, the special needs population student can become climatized to the laboratory/shop and can begin to learn the tools, equipment and materials of the program. The shadow technique can also be added to increase hands-on learning.

Assessment and feedback: Student learning can be improved by frequently assessing students' skills and feeding back their strengths and weaknesses. Through a process of positive feedback, the student can be moved gradually from where he or she is to the level of skill required.

These instructional strategies can be used independently or in various combinations. This brief list is meant only to provide you with some suggestions, there are no doubt many other techniques that could be used. The creative instructor will be constantly innovating to meet the needs of particular students.

Implementing the IEP

Step Five is a matter of putting the vocational aspects of the IEP into operation. The activitivation of the IEP initiates the student into the vocational education program and allows him or her to progresses at his or her optium rate through the modified curriculum. There should be frequent assessment activities that indicate where the student is relative to the IEP objectives. If problems are detected, a staffing should be conducted to re-evaluate the IEP and continue the process in a fashion that is most beneficial to the student.

Step Six will take the student to his or her next logical step of either totally exiting the system or recycling into a continuing education mode. In most cases, the student will do some of both--getting a job and periodically accessing the continuing education component of the educational system to refine existing skills or to broaden his or her capacity.

The ultimate goal of all this effort is not employment-rather it is "successful employment". Successful employment implies that not only is the student placed in a job, but that the student is able to sustain himself or herself in a working environment over an extended period of time.

Evaluation

Evaluation of the student's program is a critical step. Through that process we not only help the current student, but we are able to gather information that will improve our potential to help students with similar difficulties in the future. A well rounded evaluation system should consist of the following activities:

-En-route evaluation (formative) to monitor the student's progress through the program.

-Summative evaluation upon completion of the program to determine job readiness.

-Follow-up after placement to determine if the student is successful on the job.

-Follow-through activities designed to identify any further training needed, which may be indicated by the follow-up procedure.

RESOURCES

In recent years, mainstreaming of special needs population students has been an area of great concern to vocational educators. The overall result of that concern is an abundance of well developed resource materials and a variety of personnel with special skills in working with these groups. In the space allowed by this curriculum guide, it would be impossible to present an adequate set of methods and procedures for solving the problems of students with special needs, but if the vocational education administrator and instructor will judiciously use the human and material resources listed here, much of the in-depth information required for the special and unique cases that will occur can be compiled from these sources.

Support Personnel or Systems

As was noted earlier, you the vocational instructor, simply do not have sufficient skills to work with special needs population students alone. There are too many different student problems to ever allow an instructor to deal with them all on a "come as you are" basis. For that reason, you must make yourself aware of the variety of support systems and personnel that are available to you and to the students. A few of these are listed here. These specialists can lead you to others on an as needed basis.

County Health Department - Many of your special needs population students will need some medical and dental assistance. The county health facility is an excellent referral source for these problems.

Special Education - Through local boards of education there are a variety of special education personnel available locally, regionally and from the State Department of Education. The vocational education administrator can obtain assistance from these specialists through the local superintendent's office.

Project SERVE - Project SERVE is a statewide effort to acquire materials and to cultivate expertise in providing vocational education to disadvantaged. Project Serve can be contacted by the area vocational-technical director or the vocational supervisor.

Vocational Rehabilitation - Vocational rehabilitation is a highly developed organization whose major focus is all dimensions (such as: diagnosing, training, job placement and counseling) of the handicapped population. Within that network is a vast pool of expertise. You can contact it through the area vocational rehabilitation counselor who calls on your school or vocational rehabilitation through a designated school official such as the vocational supervisor or school counselor.

Related Vocational Instruction - The RVI program is designed to provide special education and support instruction to secondary vocational education programs. Although an RVI instructor is not available to every school, they are a valuable all around resource in the schools where they now work.

Coordinated Vocational and Academic Education - CVAE is a prevocational program designed to assist disadvantaged students in developing the basic skills required to succeed in vocational education and in entering an appropriate program. The CVAE coordinator and the interlocking team of teachers are an excellent resource to the vocational instructor who is working with the disadvantaged in regular vocational eduction programs.

All of the resources and resource personnel listed here are a part of the team. The best results can be obtained by using as many of these people and their support systems as possible from the beginning. In some situations, you will miss a resource in the beginning or the student's needs change. When that occurs do not hesitate to call on the appropriate experts for additional help. As a matter of fact, the rule of

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thumb that has always been used in the "helping professions" is to go as far as you can, then refer. Do not hesitate to call for help. Most of these service groups are funded to support "your" student. If you do not use them, they fail in their mission and you fail in yours.

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APPENDIX C

Definition of Terms

DEFINITION OF TERMS

1. A/Vs-Audiovisuals - May refer to any picture and/or sound media. (ie. slides, tapes, filmstrips, 16 mm films, etc.)

2. Checkpoint - A student-instructor interface point wherein the instructor may give the student a test, perform a demonstration, or simply provide the student with additional needed information or instructions. Also a checkpoint may be used for motivational purposes.

3. Competency - The ability (knowledge, skills and attitudes) to perform all of a group or cluster of related tasks required to complete a designated activity according to occupational standards. In the educational setting, the statement of a competency includes expected student outcomes in terms of knowledge, skills and attitudes required to complete a designated activity as defined by incumbent workers according to the standards of the work place.

4. Course - A grouping of tasks and competencies which have a common knowledge base or are within a given domain.

5. Criterion-Referenced Measure - An exercise based upon a performance objective, the accomplishment of which measures attainment of that objective.

6. Criterion-Referenced Test - A test designed to measure student competencies based on job or industrial standards.

7. Curriculum Guide - A document containing the objectives, content, organization and structure of an instructional program. It is designed for use by administrators, instructional supervisors and teachers.

8. D.O.T. - Abbreviation for Dictionary of Occupational Titles. Document provides nine digit codes identifying each occupation.

9. Duty - One of the distinct major activities involved in the work performed. A Composition of related tasks.

10. Exit Point - A pre-determined point within an instructional program in which a student may exit with the essential competencies for a specific job. Usually defined in terms of D.O.T. codes and/or O.E. codes.

11. "Hands-On" - Statement implying the student is physically involved in a learning activity.

12. Individualized Instruction (I.I.) - A system of instruction allowing a student to progress at his/her fastest rate.

13. Job - A specific area of specialization within an occupational field consisting of several closely related duties for which a person would expect to receive remuneration. Should be identified by DOT code.

14. Job Sheet - (Or Operations Sheet) - A project of a performance nature. Generally performed by the student in a lab or shop type environment or in a specialized work area.

15. Live Work - Generally refers to items brought into the course area for repair or adjustment. Examples of live work might be automobiles, radios and TV's, air-conditioners, etc. Another form of live work would be patrons visiting the cosmetology department to receive permanents or other services.

16. Master Copies - Original copies of slides, tapes or written materials set aside for the purpose of duplication.

17. Occupational Cluster - A group of occupations sharing a common core of competencies. Georgia's comprehensive high school vocational program is organized around this concept.

18. Occupational Inventory - A listing of tasks to be performed in a particular occupational area, grouped under duty classifications.

19. O.E. - Refers to the U.S. Office of Education. O.E. codes are a classification system (taxonomy) for occupational education programs.

20. Open Entry - Term meaning that a student may enter the program at any time and does not have to wait for quarter or semester breaks.

21. Open Exit - Term meaning that a student may leave a program any time he/she completes occupational objectives.

22. Performance Guide - A series of steps arranged in a sequence which when completed may result in the performance of a task. Also called teaching steps.

23. Performance Objective - A statement in precise, measurable terms of a particular behavior to be exhibited by a learner underspecified conditions. It possesses each of the elements or characteristics specified below:

    a. Condition - The testing situation confronting the learner is clearly specified. This includes equipment provided or withheld, environmental constraints such as temperature, space, etc.

b. Performance - The specific behavior expected of the learner is stated.

c. Standard - The degree of acceptable performance is specified.

24. Performance Test - A test entailing not only the ability to answer questions, but measuring the student ability to operate, manipulate or perform a given task.

25. Program - An organized sequence of courses leading to an occupational objective. A program may contain one or more student exit points as defined by D.O.T. codes.

26. Program Objective - The outcome of a prescribed program of instruction. Usually expressed in terms of the occupation or job for which training is designed. D.O.T. codes are frequently used to identify program objectives or student exit points.

27. Self-Paced - Refers to a student moving through the prescribed training program at the fastest pace at which he/she can meaningfully learn.

28. Sequencing - Putting any set or series of learning activities or tasks into proper order or sequence. Normally arranged from simple to complex within groupings or blocks.

29. Software - Written or printed materials, slides, filmstrips, tapes, etc.

30. Student Manual - A document designed for use by students in a specific instructional program. It contains unit sheets, references, operational procedures, job sheets, etc.

31. Task - The smallest division of work in which a measurable output occurs. A logical and necessary step in the performance of a duty.

32. Task List - A listing of tasks performed by incumbent workers within a domain of interest. An example is a listing of all tasks performed by an automotive mechanic or by a worker in ornamental horticulture.

33. Unit - One "module" training material that generally covers one learning task and programmed on one unit sheet. May cover more than one lesson.

34. Unit Guide - A curriculum guide sheet that lists a task and objective with the instructional activities, instructional materials, evaluation and approximate time required for a student to successfully complete the task.

35. V'TECS Catalog - A comprehensive collection of performance objectives, performance guides, criterion-referenced measures and related data. Organized by a job structure or career ladder within a domain of interest.

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Title II - Loydia Webber, Vocational Equity Coordinator
Title VI - Peyton Williams Jr., Associate Superintendent
of State Schools and Special Services
Title IX - Evelyn Rowe and Myra Tolbert, Coordinators
Section 504 - Jane Lee, Coordinator of Special Education

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